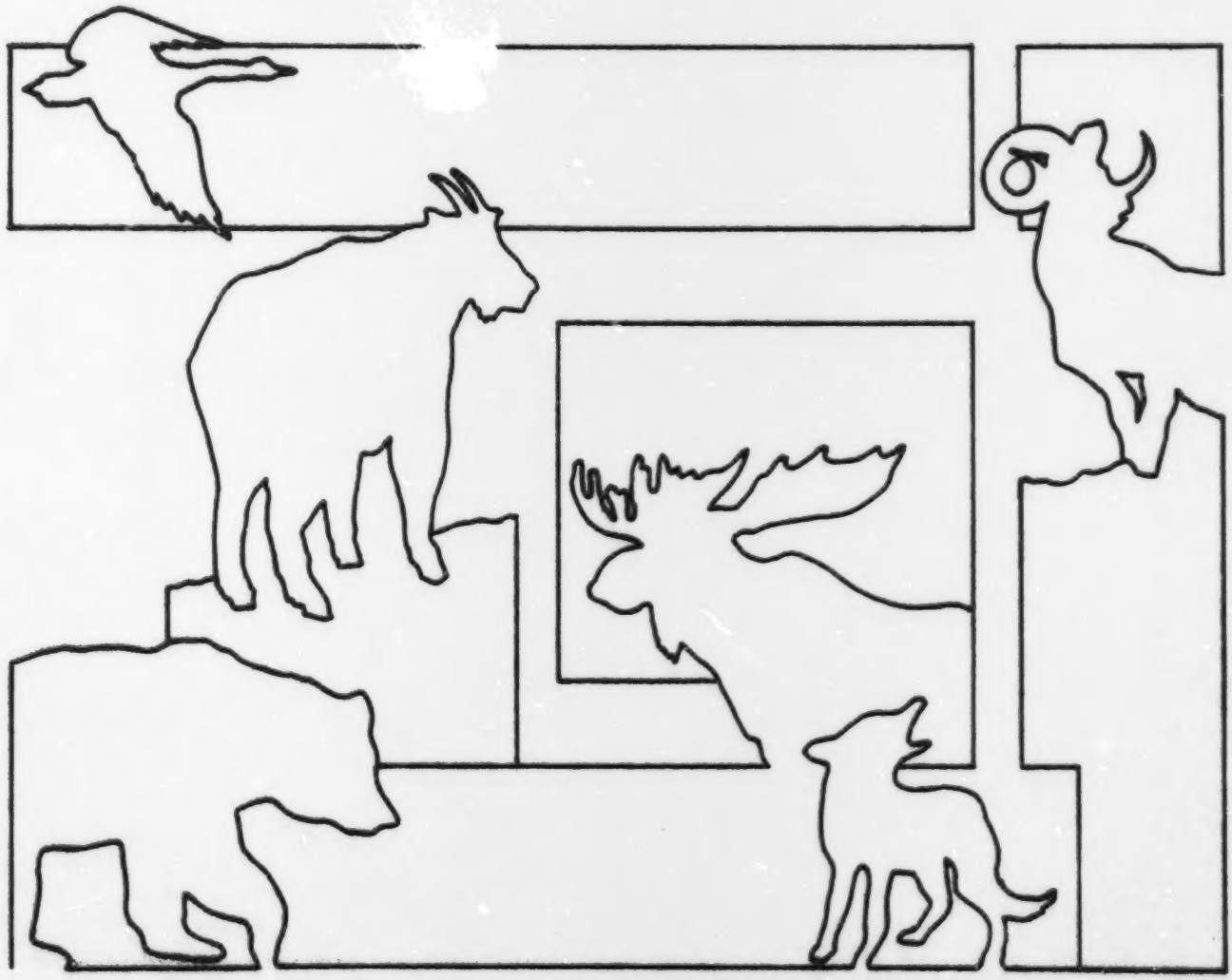
# WILDLIFE

## Factors Affecting the Fall Staging of Waterfowl at Nisutlin Delta, Yukon

*Project Report : Wildlife No. 3*



YUKON RIVER BASIN STUDY

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Yukon

# FACTORS AFFECTING THE FALL STAGING OF WATERFOWL AT NISUTLIN DELTA, YUKON

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## INTRODUCTION

The use of wetlands by waterfowl at various locations during fall migration throughout the Yukon River Basin is undoubtedly an important wildlife process that potentially will require management decision in the future. Waterfowl "staging" is generally seen as a process by which these birds concentrate on suitable habitats during stops in migration as a strategy to replenish energy reserves prior to major movements (Welty 1962).

Understanding the use made of Yukon habitats by the several million birds migrating annually through the area, is in its infancy. The general purpose of the present work was to concentrate research on one example of fall staging habitat and waterfowl survival strategy occurring there, identifiying and measuring components of that system which may be sensitive to management in the future. Extrapolation of the results to similar systems throughout the Yukon River Basin would be possible only at a very gross level but could lend valuable insight to the magnitude of future water management decision affecting fall staging sites.

The Nisutlin River Delta, located in the southeastern portion of the Yukon River watershed, (60°12'-133°30'), is one of the best known fall staging habitats for waterfowl in the southern Yukon (Foothills 1977, Osborne 1979). The sand and silt delta is formed where the Nisutlin River flows into Teslin Lake, approximately 16 km from the community of Teslin, Yukon. The Nisutlin River valley, with its well developed flood plain and its delta has been of great importance to early inhabitants of the area. More recently, it has received some attention from researchers who have described its various

features (Mulligan et al, 1974; Hoefs, 1976). The flood plain vegetation is known to be relatively productive (Oswald, 1979), and various wildlife species are also concentrated there. The area has been the object of a proposed International Biological Program (IBP) site; it has been proposed as a Migratory Bird Sanctuary, and as a National Wildlife Area. It appears in hunter effort analysis as the most important single area of recreational waterfowl harvest in the Yukon Territory (Y.T.G. harvest analysis statistics, 1978 - unpubl.).

Some focus for the research was provided by the fact that water management plans could include changes to the flow regime in the Nisutlin River (N.C.P.C., 1975), this was seen as a fairly general prospect for similar habitats throughout the river basin and hence effort concentrated on understanding the effects of water level and timing of flow on the process of waterfowl staging. In spite of this, in keeping with the general state of the developing institutions of resource management in the Basin, the work was largely exploratory.

## OBJECTIVES

(1) Determine the identity of waterfowl populations using the delta, their numbers and timing of use.

(2) Determine the important habitats of the delta and the specific use being made of various parts by birds.

3. Determine the interrelationships between water level changes and various habitats used by waterfowl.

4. Describe waterfowl behavioural strategies used during staging and identify factors affecting it.

5. Explore the feasibility of extrapolating findings to other wetland areas in the Yukon Basin.

## STUDY AREA

The Nisutlin River originates in the Pelly Mountains of the south central Yukon Territory and flows generally southward (Figure 1). It enters Nisutlin Bay of Teslin Lake at an elevation of 682.4 m A.S.L. (2,239 ft.). Here the lake shore is formed of large and small low profile islands divided by many shallow channels and vegetated by balsam poplar forest grading into willow shrub on its outer edges. During low water most channels carry no water while in high annual water much of the delta including the shrub zone, is inundated. A feature of Teslin Lake is its large (5 meter) annual variation in level. The delta has a southern prospect.

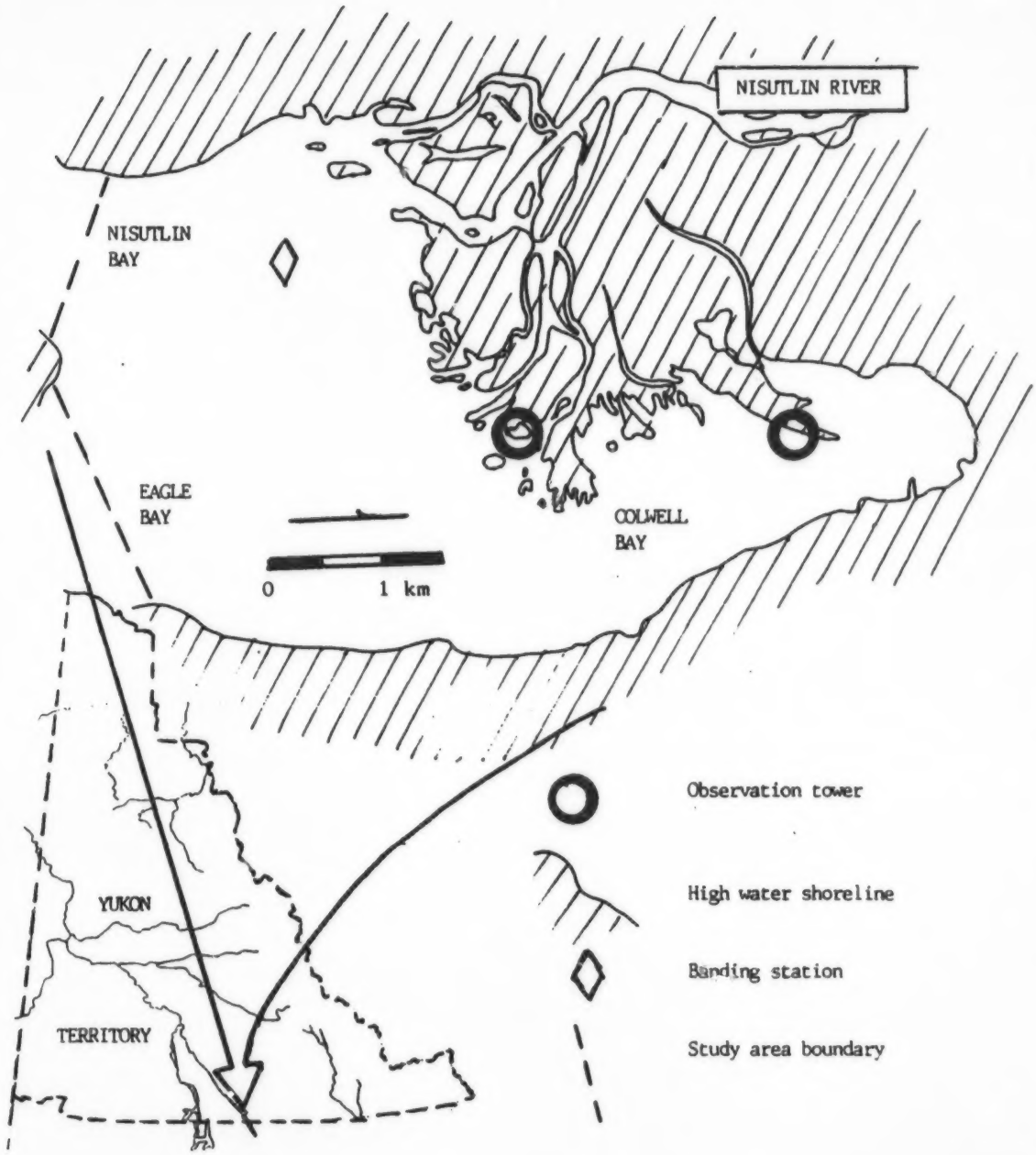



Figure 1. The Nisutlin Delta, showing the study area and its location in the south central Yukon Territory.

Formation of the delta has resulted from a variety of forces (Geist et al 1974). Much of the substrate is rather firm sand; the surface material is silt. Silt deposition and building of the delta is thought to be enhanced by prevailing south-westerly winds which blow against the outflow as well as the large amount of logs and debris which are stranded in the delta impeding outward flow (Hoefs, 1976). The river carries solids principally during spring and summer cresting. By late summer the river water is clear.

The outer shrub-free area of the delta was the general study area. It extends in an arc 6 km in length varying in width depending on water level. The active delta deposits extend abreast Eagle point (3.0 km) but average water level during fall rarely exposes 2 km of them. The average fall area of the exposed shrub-free delta is approximately 10 $km^2$ (Figure 1).

## METHODS

Some aspects of this study were ongoing since 1979. The intensive field program covered only the years 1981-83. In these years field work commenced approximately August 1 annually and ceased at freezeup - approximately October 15.

A. Observations of bird numbers, movements and habitat use

Bird numbers, movements and habitat use were monitored through the use of raised observation platforms constructed at the edge of the shrub zone (Figure 1). A 20x spotting scope was used to identify and count birds. The following categories of waterbirds were counted:

Swans

Geese (normally by species)

Dabbling ducks

Diving ducks

Counts were made every third day in 1981 and daily in 1982 and 83. Instantaneous counts were made on a 16-day schedule which shifted through the daylight period. Presumably this would give a measure of daily variability. Additionally, during all ground work, daily notes were kept on all species encountered, relative numbers of waterfowl species and estimates of total abundance.

Habitat use was quantified by direct observation from the observation towers. During this activity as well as most investigations of behavioral strategies, concentration was on Canada geese. The geese were the most obvious waterfowl group using the area. Air photos were used to accurately map feeding and resting flocks.

Coloured 35 mm vertical photo coverage was taken at 6000' a.g.l. (2000 m) in 1982 a lowest water level. A provisional vegetation map was prepared using tonal variations evident in the photo mosaic to delineate apparent vegetation communities (Appendix I). The major communities have been

described using 1 $m^2$ plots. Species composition and cover percentage were estimated. This work will continue to refine the provisional map in the continuing phase of the work.

B. Water level recording

Water levels were recorded daily at Teslin by the Inland Waters Directorate of Environment Canada. The amount of exposed delta was noted by mapping the shore line periodically from the towers and ground. This was supported with periodic oblique 35 mm air photos (Figure 2). Habitat use was correlated with water levels.

C. Disturbance and natural predation

Hunting pressure, predation and disturbances were measured through a direct count of hunter effort, natural predator counts, and goose behavior. All shots fired were counted and all hunting groups were located on a base map. Most were interviewed and their bag recorded. Natural predators were recorded whenever observed. A lure pigeon was used in all falls to periodically assess the number of raptorial birds hunting the delta. The pigeon was "shown" for 2 hours at dawn and dusk, weekly through 1981 and 82, and only periodically in 1983.

D. Banding of Dabbling Ducks to identify populations

Federal leg bands were used to mark birds on the delta in an attempt to begin identifying populations using the area. In order to produce meaningful results with limited resources, concentration was on dabbling

ducks, one banding station with two funnel traps baited with a variety of grains was visited daily.

Band returns were located on continental maps to identify the flyway used by waterfowl banded at Nisutlin Delta.

E. Alternate Staging Areas

The Teslin Lake basin was aerially surveyed in late August, 1982 for minor staging sites that would provide alternative habitat for birds at Nisutlin Delta. Sites were recorded on maps and waterfowl were counted.

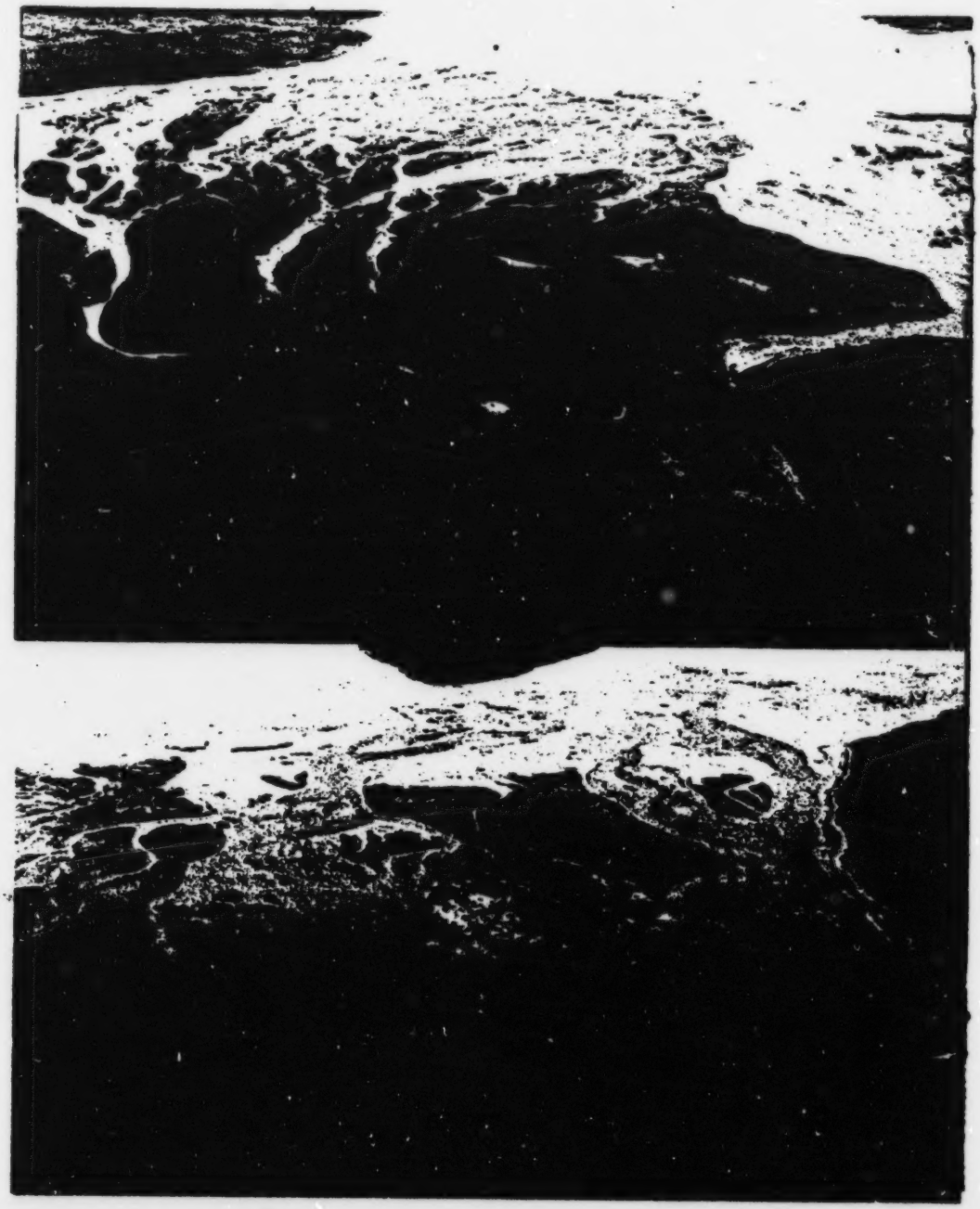


Figure 2. Oblique aerial views of the Nisutlin Delta showing extent of exposed habitat during fall draw-down 1982.

## RESULTS

### A.(1) Waterfowl Numbers

Ducks: Four dabbler species made up by far the major portion of ducks using the delta in the 3 years of the study (Table 1). Diving ducks, though a minor element in this analysis, did utilize the outer delta. They may occur in numbers greater than recorded; our technique probably underestimated numbers of birds on the water beyond the exposed delta.

Table 1: Duck species using Nisutlin delta in fall and estimates of numbers at peak density for that species.

| Species (decreasing numerical importance) | 1981 | 1982 | 1983 |
|---|---|---|---|
| American wigeon(*Anas americana*) | 2500 | 2000 | 1600 |
| Mallard (*Anas platyrhynchose*) | 1600 | 1500 | 1800 |
| Northern pintail (*Anas acuta*) | 500 | 500 | 400 |
| Green-winged teal (*Anas crecca*) | 200 | 600 | 300 |
| Common goldeneye (*Bucephala clangula*) | 200 | 300 | 300 |
| Surf scoter (*Melanitta perspicillata*) | 100 | 100 | 100 |
| Scaup spp. (*Aythya spp.*) | 50 | 100 | 50 |
| Bufflehead (*Bucephala albeola*) | 10 | 20 | 25 |
| Northen shoveler (*Spatula clypeata*) | 25 | 50 | 50 |
| Canvasback (*Aythya valisineria*) | 5 | 15 | 5 |
| Harlequin duck (*Histrionicus histrionicus*) | 1 | 0 | 15 |
| Blue-winged teal (*Anas discors*) | 10 | 10 | 0 |

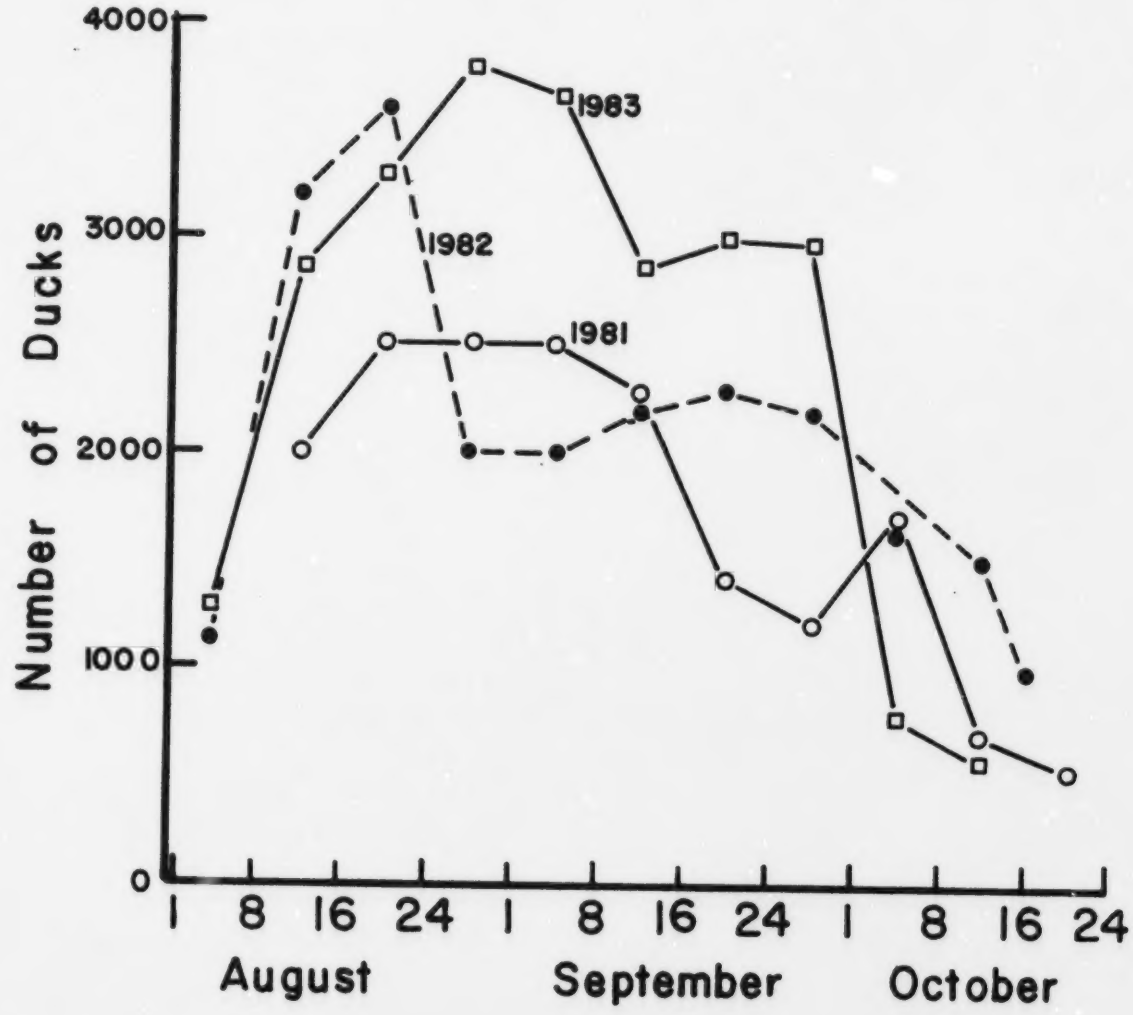



Figure 3. Total ducks counted from observation towers through fall staging period 1981-83 Nisutlin Delta.

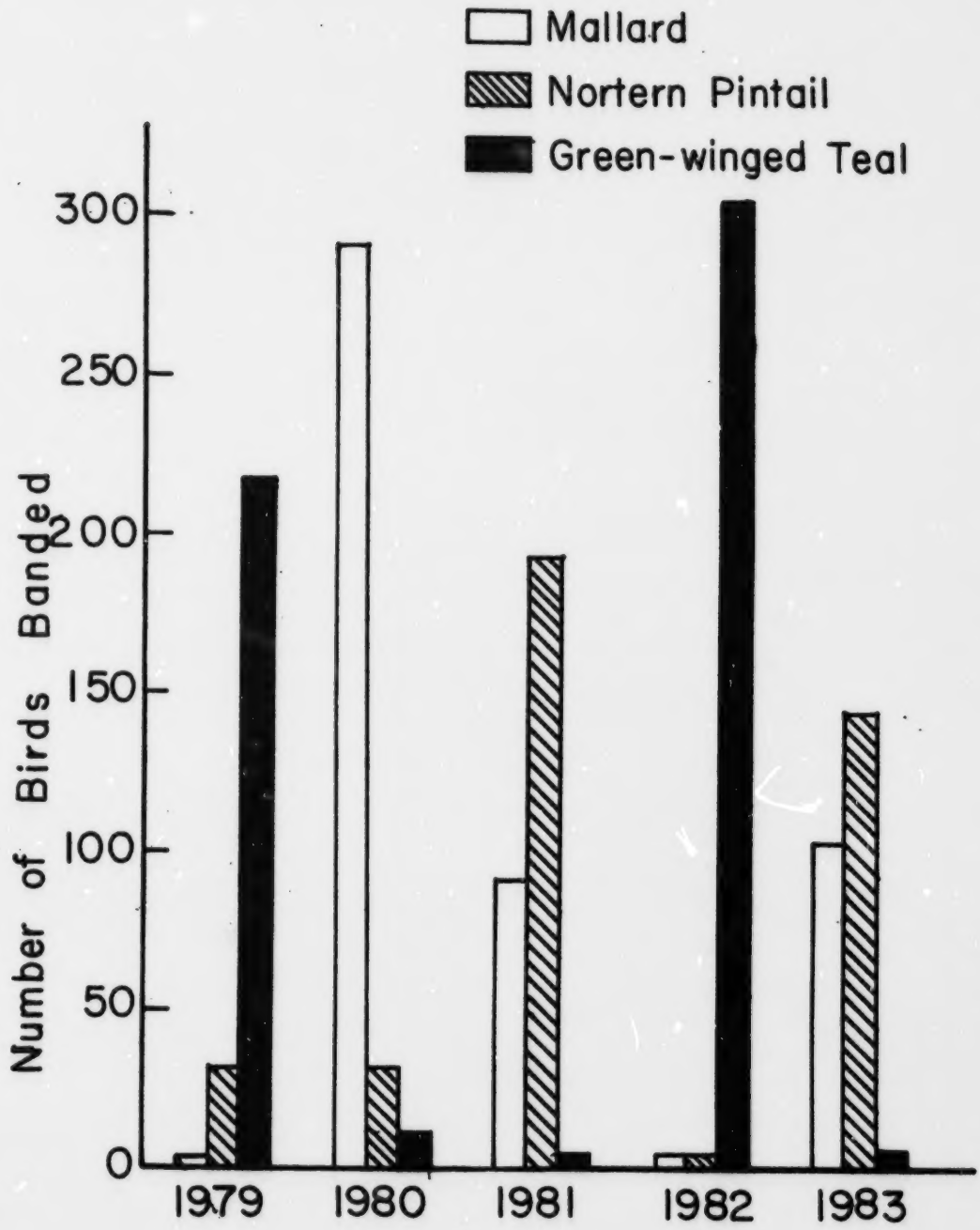



Figure 4. Total number of dabbling ducks band on Nisutlin Delta from 1979 to 1983.

The tower counts pooled all duck species. They suggest a minimum peak annually of approximately 4 thousand individuals (Figure 3). Some variation did occur between years. Species composition of the duck group apparently varied dramatically between years. Our duck capturing techniques did not vary between years, yet species composition of the catch changed markedly (Figure 4). Clearly the importance of the delta habitat for staging ducks must be assessed taking this variation into consideration. Duck numbers in any one year give a distorted picture.

Duck numbers peaked in late August each year and fell off steadily through to freezeup (Figure 3). Turnover in this group of birds could not be measured directly. The amount of turnover as indicated by our captured sample (Figure 5), showed that at least some birds banded early in the fall were recaptured until the end of the staging period, suggesting that even though arrival occurred in several waves, birds were staging though to freeze up. The probability of a mallard captured in the first week of banding appearing as a recapture in the last week did not vary significantly from the observed rate (Expected 3.57 observed 4.0).

The number of days of duck use (1 duck day = 1 duck spending 1 day on the delta) provides a comparative measure of the importance of the delta in the three years of intensive study (Figure 6). Some variation is evident with 1983 providing a high of somewhat over 175 thousand duck use days and 1981 providing a low of about 130 thousand. Because our daily counts were designed primarily to monitor goose numbers, duck counts were likely less accurate. However, duck use of the magnitude recorded, given the restricted area of the delta represents some of the more heavily used waterfowl habitats in the Yukon (Johnston and McEwen, 1983).

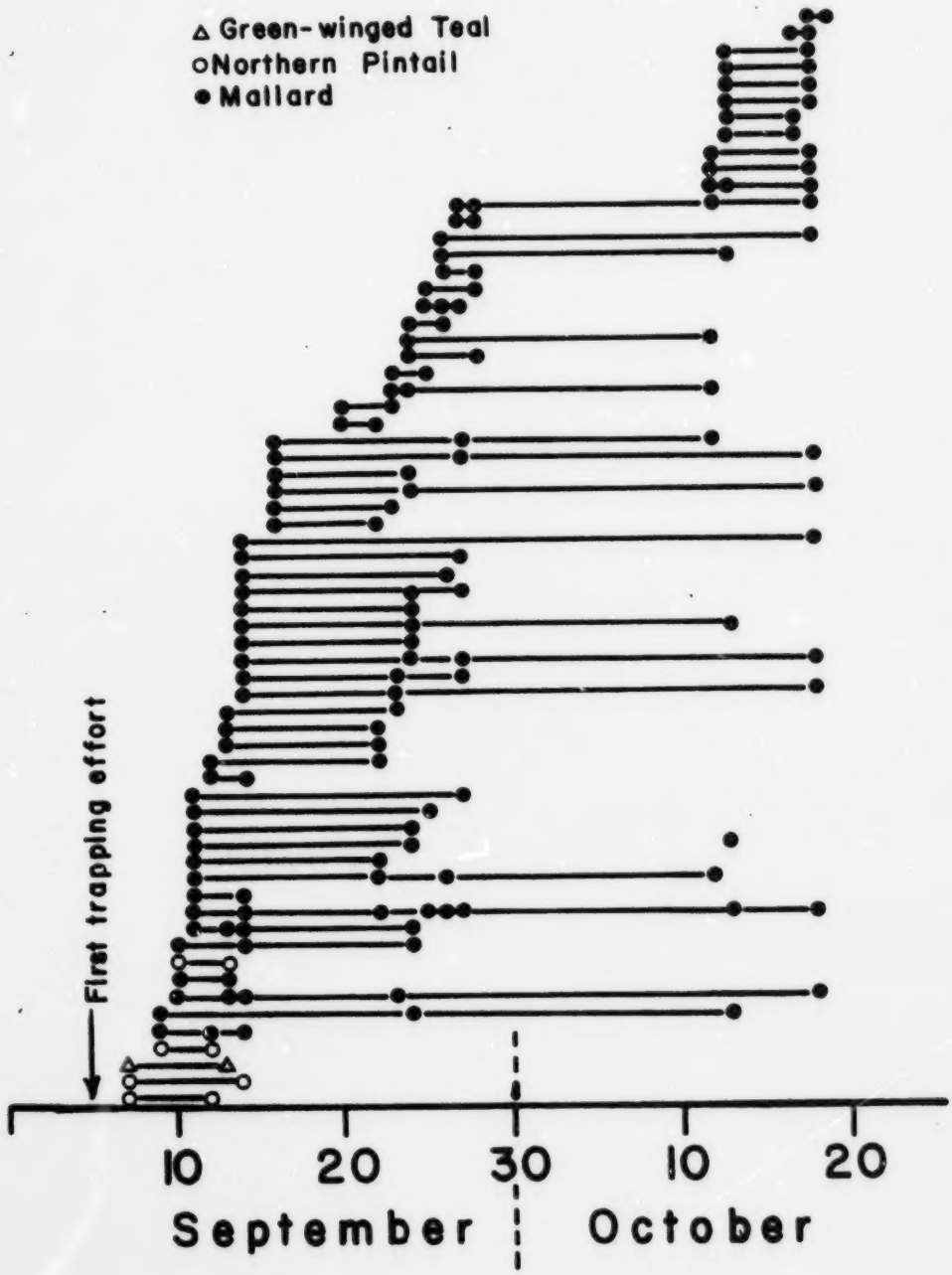



Figure 5. Dabbling ducks banded and retrapped in the same year on the Nisutlin Delta - data from 1980.

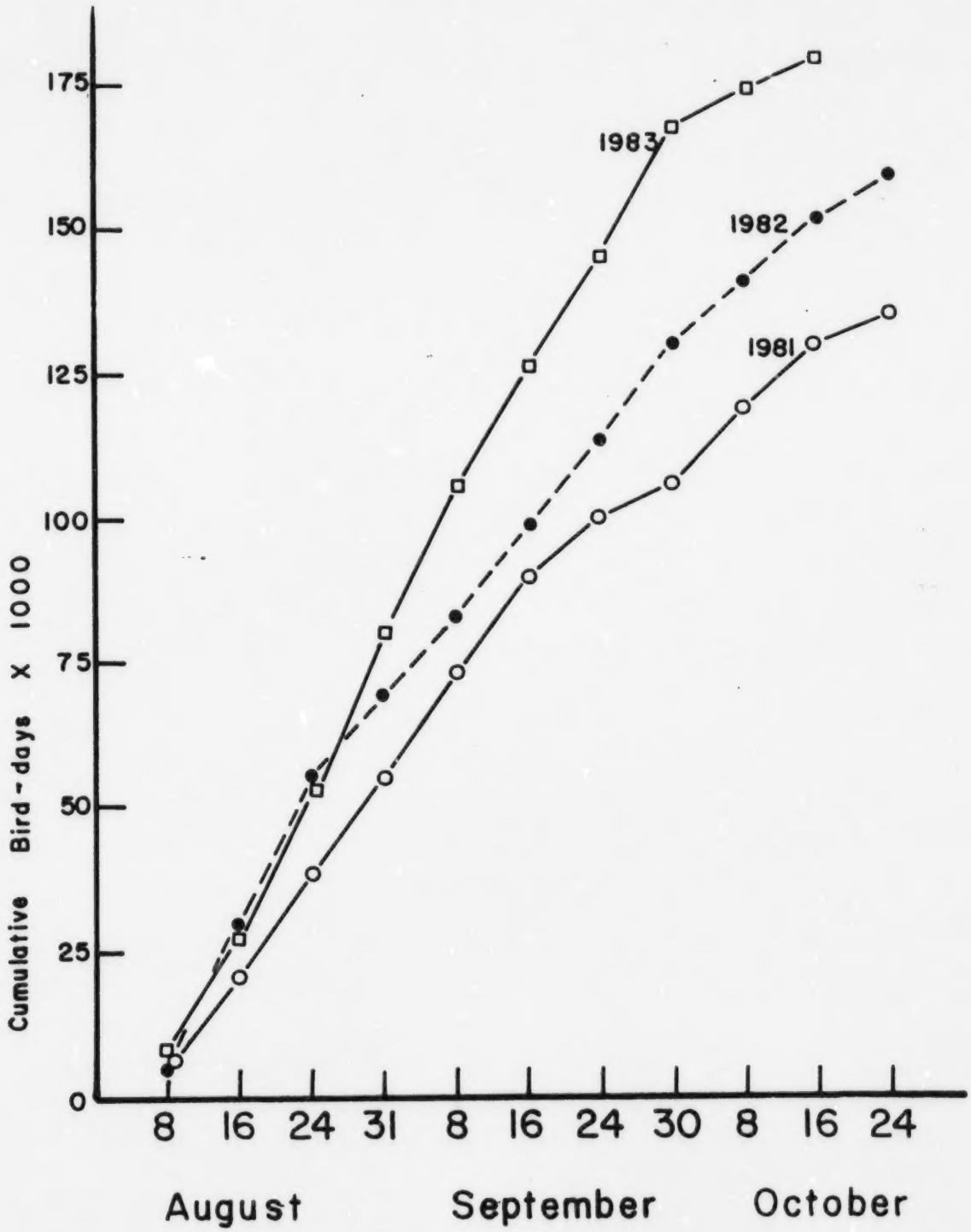



Figure 6. Number of days of duck use provided by Nisutlin Delta 1981-83.

Geese: White-fronted geese (Anser albifrons) used the delta in relatively small numbers during all years of the study. Peak numbers 1981: 70; 1982: 48; 1983: 525. One small flock of six snow geese (Chen caerulescenes) was observed several times between September 27 and October 2, 1981.

Canada geese occurred on the delta annually in numbers varying, at peak abundance, from a low of 2,077 in 1981 to a high of 3,870 in 1982 (Figure 7). Time of arrival was annually about the last week of July and peak numbers normally occurred in early September coincident with the opening of the hunting season. Following, the numbers again built toward peak density by late September. Most variation occurred in the timing of goose departure and in the numbers remaining through late September and October. 1981 and 1983 resembled one another with departures occurring near the beginning of October. In 1982 goose numbers remained relatively high well into October; departure occurred in mid month.

The uniqueness of 1982 is borne out in an analysis of goose-days of use provided by the delta (Figure 8). That year provided about twice the number of goose-days of staging as did the other two years.

We were not able to assess tunover in the goose flock during the study. Some obvious variations in counts betweeen days, notably in early September seems to relate to major movements of birds to and from the delta. But we have no indication of whether these were new arrivals or the same birds departing and returning.

Swans:Both trumpeter (Cygnus buccinator) and tundra (C. columbianus) swans staged on the delta each year. Small numbers of trumpeter swans arrived in mid

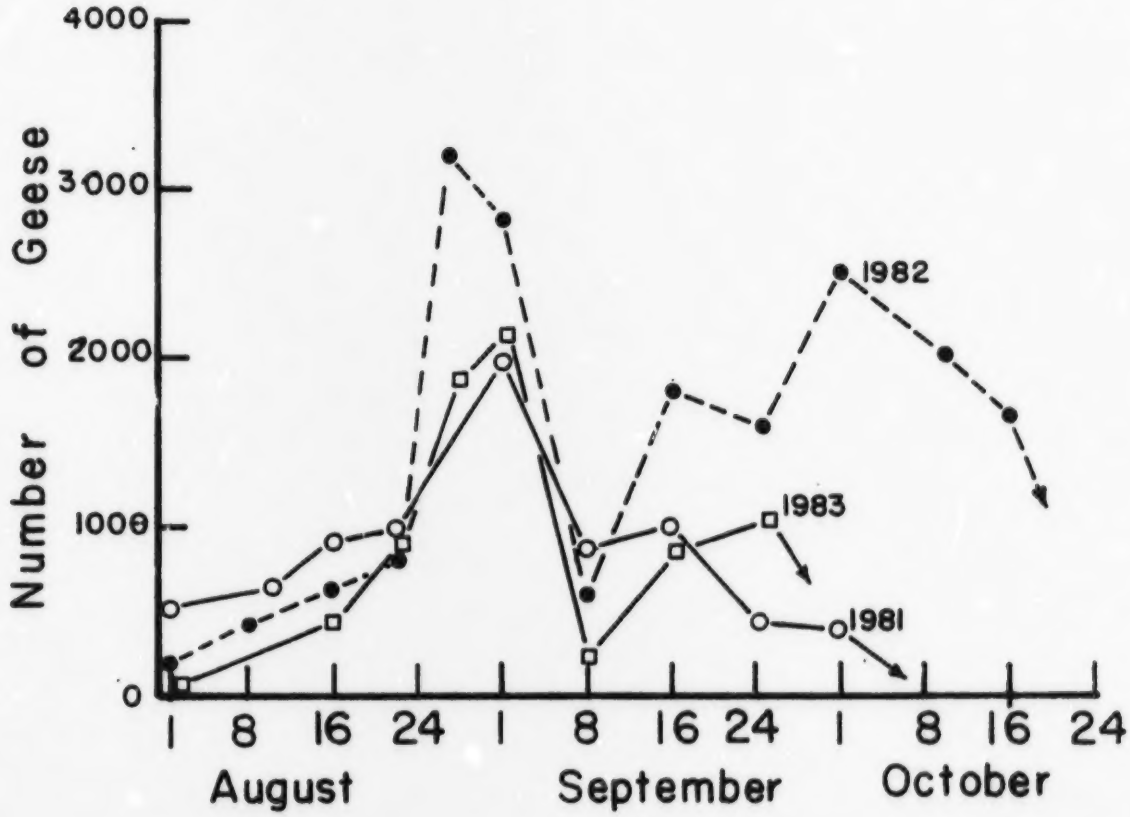



Figure 7. Number of Canada geese counted from observation towers, Nisutlin Delta 1981-83.

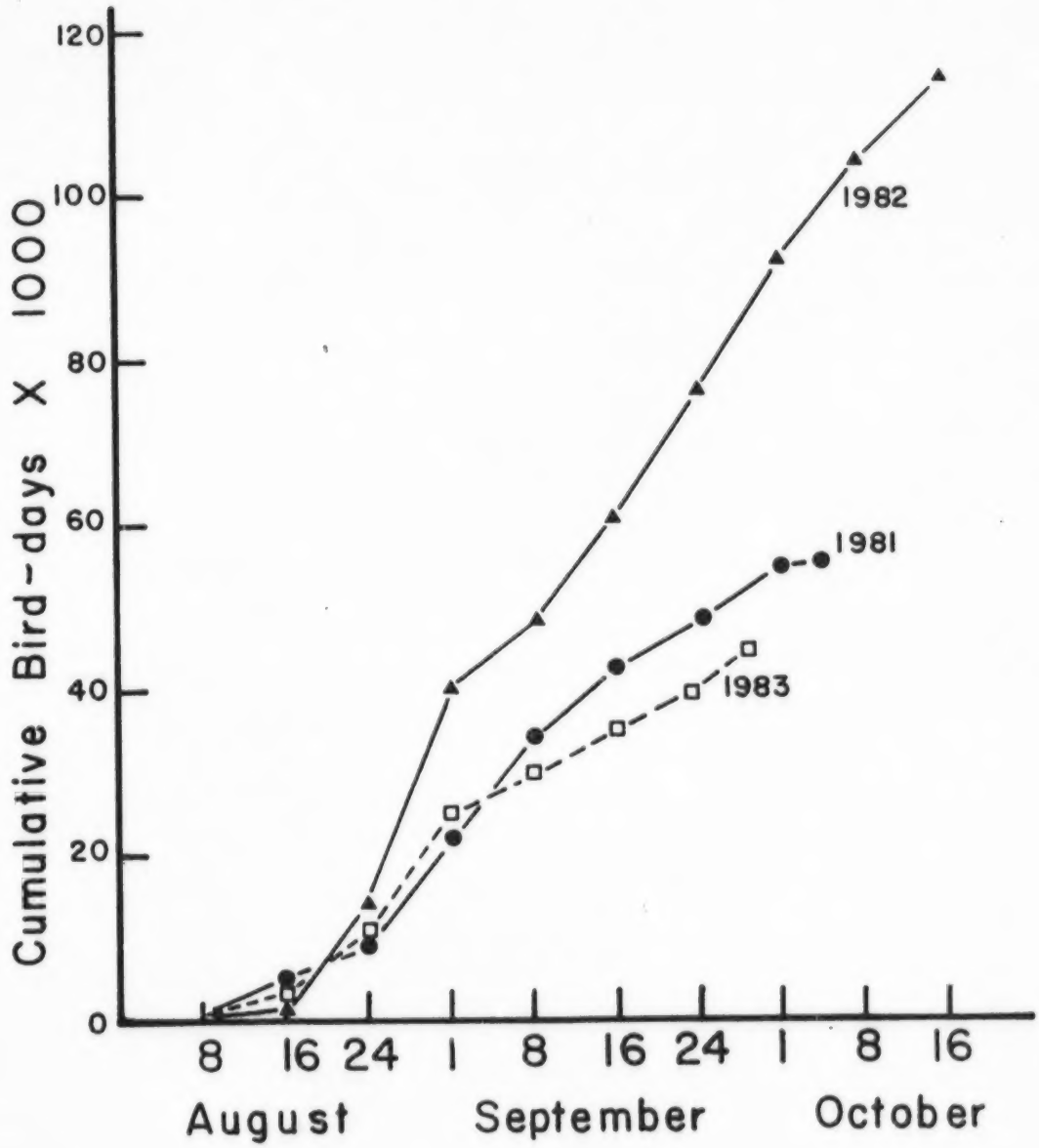



Figure 8. Number of days of goose use provided by Nisutlin Delta 1981-83.

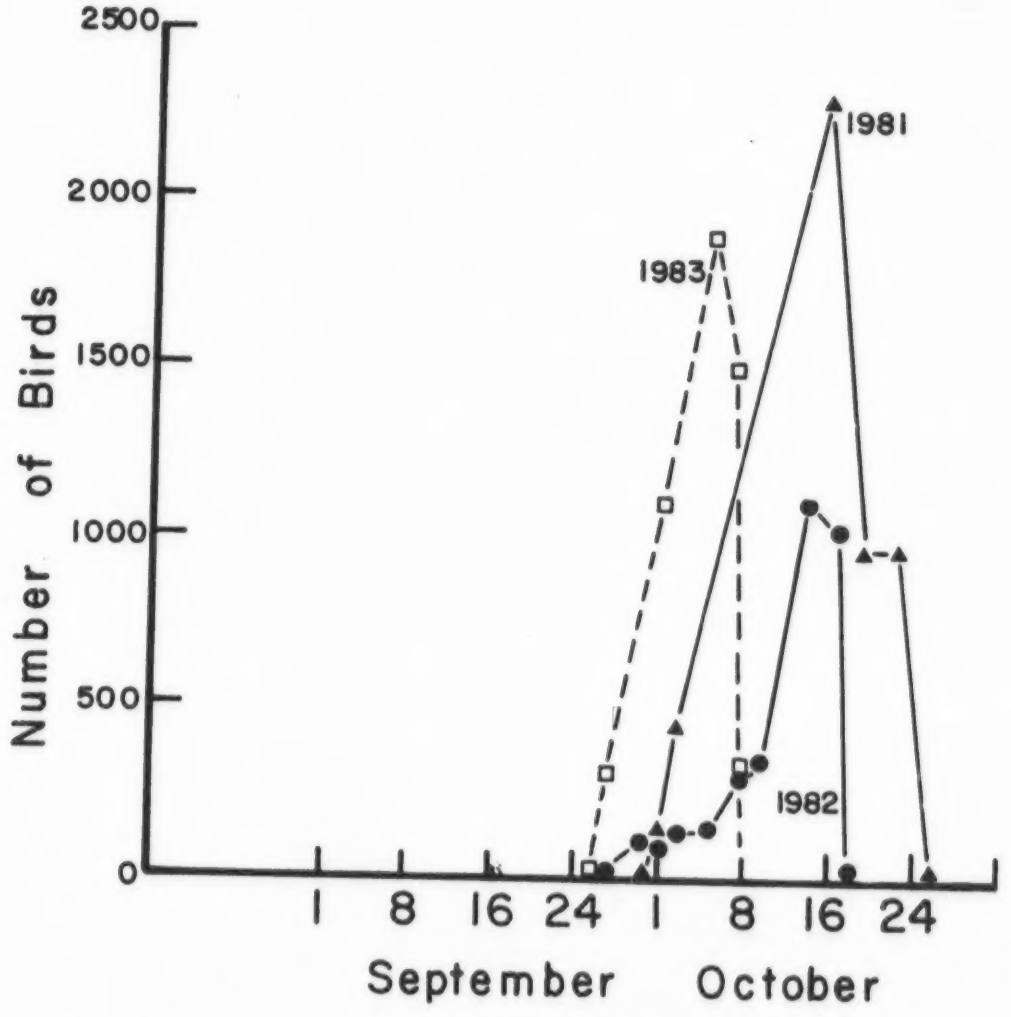



Figure 9. Numbers of swans counted from observation towers, Nisutlin Delta, 1981-83.

September but their numbers quickly became obscurred by the arrival of the large flock of tundra swans in late September. An estimated 25-50 trumpeters used the delta annually. Their time of departure was not determined.

Tundra swans varied in numbers between years from a low 245 individuals in 982 to a high of 2,445 in 1981 (Figure 9). They normally arrived in late September, built quickly to peak numbers, and departed at freeze up.

Bird-days of staging provided was dependent mostly on the total numbers arriving: 1981: 13 thousand bird days; 1982: 7 thousand; 1983: 8 thousand.

D. Band Recoveries

Dabbling ducks were the only group which were captured and banded. However, A. Widgeon, the commonest duck on the area was not captured. From the sample of 1,414 mallard, pintail and green winged teal bandings, 62 returns were obtained. Most were from wintering areas (Figures 10 - 11). They indicate that dabblers using Nisutlin are mostly Pacific Flyway populations. Only one mallard return occurred in the summer. It was captured in southern Alaska.

| Species | No. Banded | Direct Recoveries | Rate |
|---|---|---|---|
| Mallard | 465 | 13 | 2.8% |
| N. pintail | 359 | 16 | 4.5% |
| A. G.W. teal | 316 | 15 | 4.7% |

Recovery rates for the three species although based on a relatively small sample are lower than those from the only other Yukon duck populations where banding has occcurred (the Old Crow Flats - Mossop, 1977).

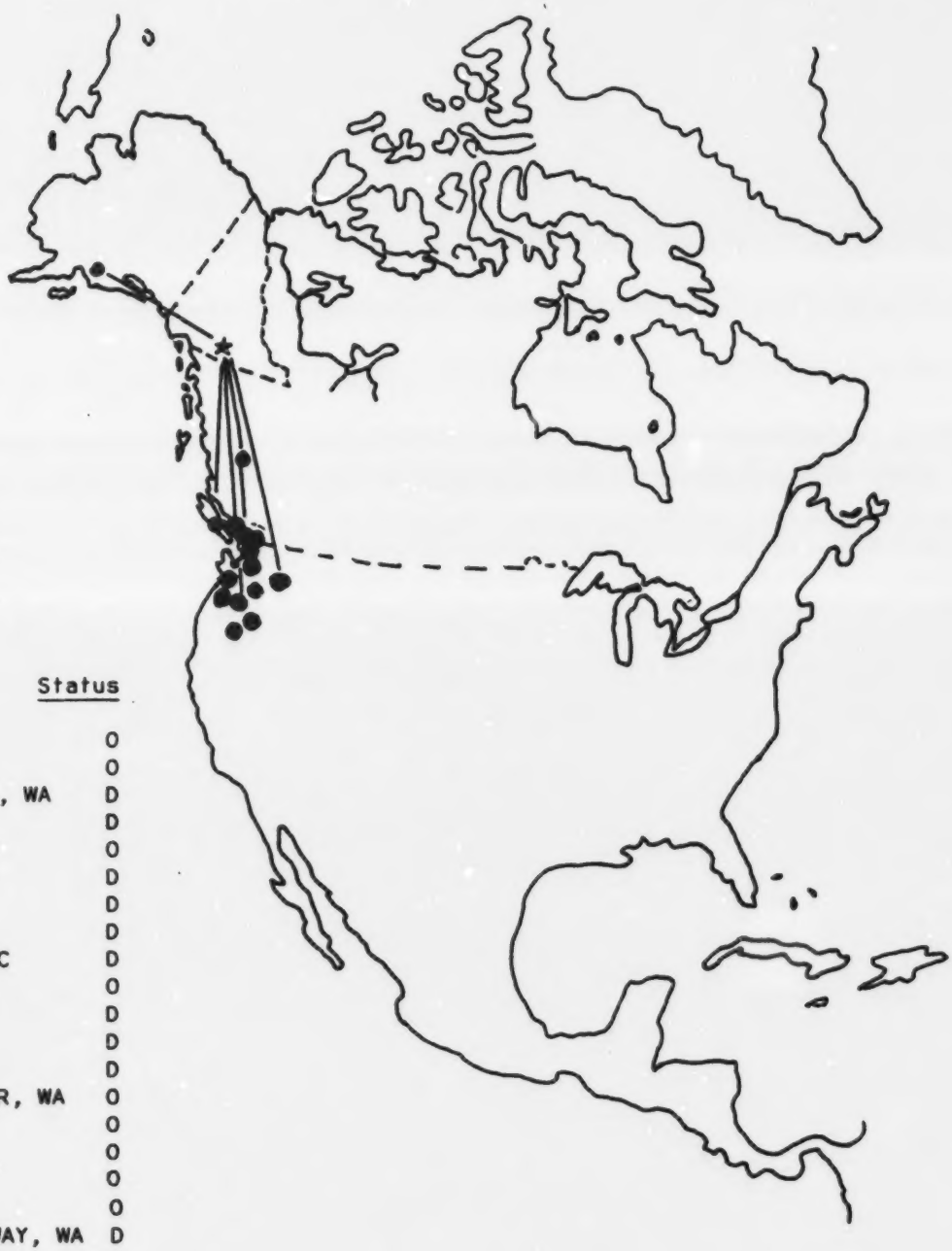
## 2. Waterfowl Feeding Behaviour and Movements

Geese: Generally Canada geese staging on the delta followed a routine of diurnal feeding and nocturnal roosting. Roosting traditionally occurred in an area of the western outer delta at waters edge of a large silt island. Exposed habitat there was primarily aquatic vegetation and mudflat. The area varied in size but was normally less than 1 km $^2$ (Figure 13).

Geese were observed to fly to their feeding areas during the morning, returning to the roosting area in evening. Modifications on this theme occurred in which birds made multiple trips to and from the roosting area, notably if feeding was disturbed during the day.

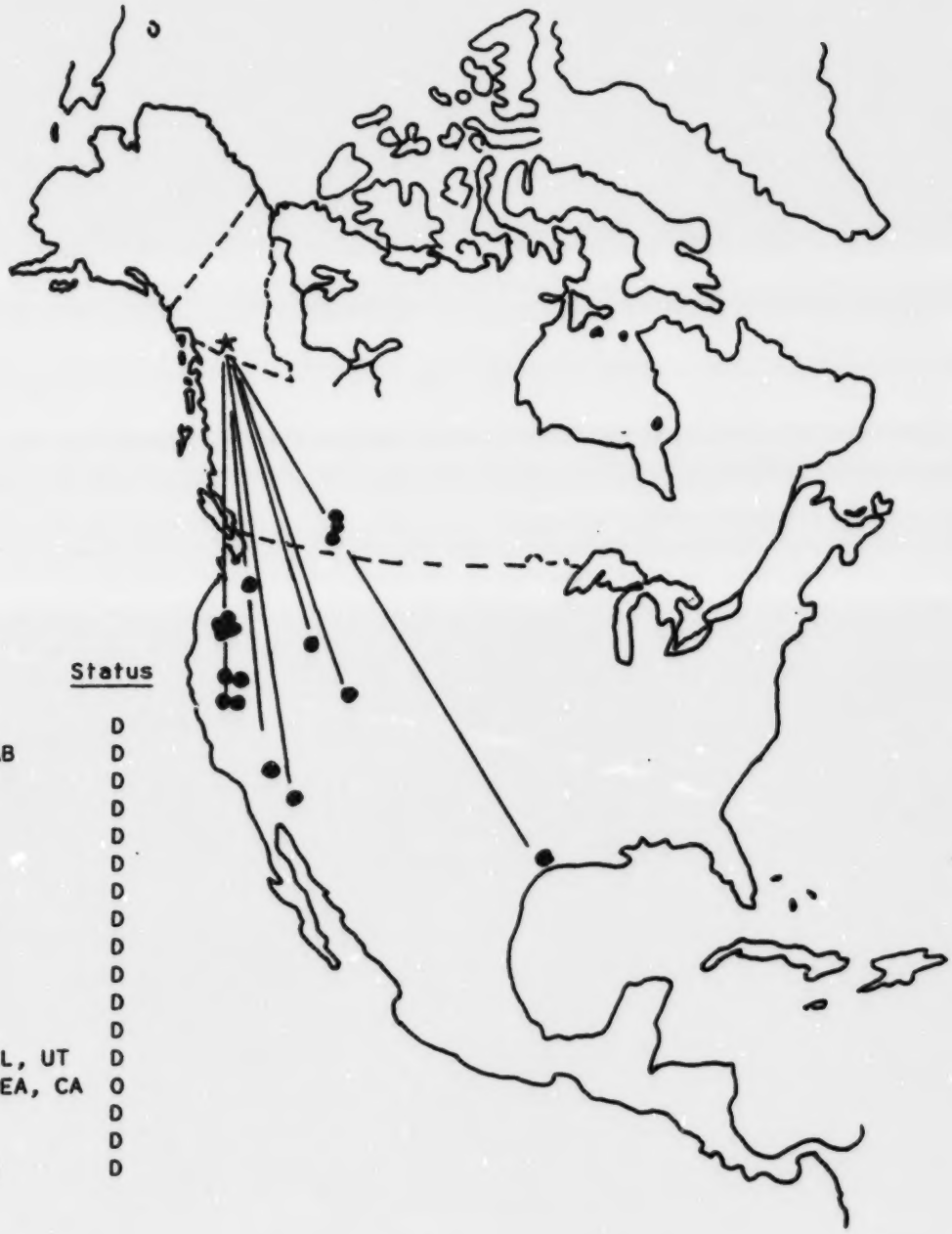
Two basic feeding behaviours were observed. One, feeding in water, generally involved excavating the tubers of aquatic plants resulting in the formation of feeding 'craters' (Figure 13).

Fig.10 Mallard Band Returns - Nisutlin Bay 1979-1983
(D=Direct, O=Others)



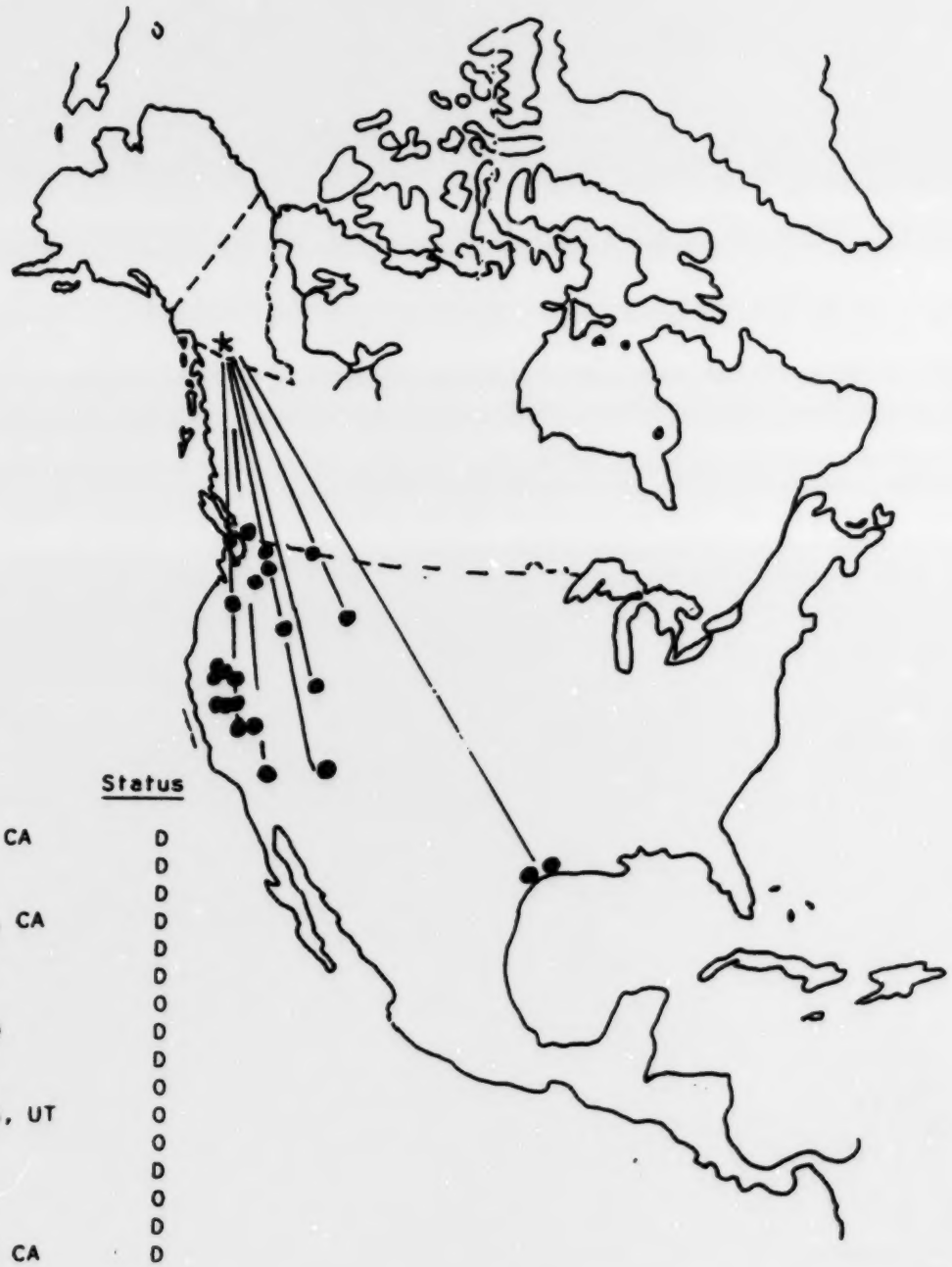
| Location | Status |
|---|---|
| PITT LK, BC | O |
| BATTLEGROUND, WA | O |
| SNOQUALMIE VALLEY, WA | D |
| LANGLEY, BC | D |
| OLD WOMAN LK, BC | O |
| 5 NE LYNDEN, WA | D |
| NORTHY LK, BC | D |
| DUYALL, WA | D |
| PITT R. BRIDGE, BC | D |
| WESTHAM ISL, BC | O |
| SKAGIT FLATS, WA | D |
| FERNDALE, WA | D |
| 5 S BLUESTEM, WA | D |
| BASKETT SLOUGH NWR, WA | O |
| EDISON, WA | O |
| NR LONGVIEW, WA | O |
| CONNORS LK, AK | O |
| EVERETT, WA | O |
| WINCHESTER WASTEWAY, WA | D |
| PADILLA BAY, WA | D |
| MARCHS PT, WA | D |
| SAUVIE ISLAND, OR | D |

Fig. 11 Pintail Band Returns - Nisutlin Bay 1979-1983
(D=Direct, O=Others)



| Location | Status |
|---|---|
| SAUVIES ISL, OR | D |
| 6 NE ROCKYFORD, AB | D |
| SAUVIE ISL, OR | D |
| SAUVIE ISL, OR | D |
| BITTERN LK, AB | D |
| 10 W PONOKA, AB | D |
| HONEY LK WA, CA | D |
| KESTERSON NWR,CA | D |
| SAUVIE ISL, OR | D |
| SNAKE R, ID | D |
| PITTSBURG, CA | D |
| NR LOS BANOS, CA | D |
| LAKE FRONT DUCK CL, UT | D |
| LK PERRIS REC. AREA, CA | O |
| KLONDIKE, LA | D |
| TULE, CA | D |
| LOWER KLAMATH, OR | D |

Fig. 12 Green Winged Teal Band Returns - Nisutlin Bay 1979-1983
(D=Direct, O=Others)



| Location | Status |
|---|---|
| NR SAN PABLO BAY, CA | D |
| 4 S CHEHALIS, WA | D |
| NR GUSTINE, CA | D |
| HOLLISTER DUCK CL, CA | D |
| GREENS LK, TX | D |
| GRAY RIDGE WA, CA | D |
| MERCED, CA | O |
| FORT HALL BTMS, ID | D |
| 10 NW CRESTON, BC | D |
| GRAY LODGE WA, CA | O |
| FARMINGTON BAY WMA, UT | O |
| CALCASIEU LK, LA | O |
| NR STURGIS, SD | D |
| PITT LAKE, BC | O |
| MOSES LK, WA | D |
| E GUSTINE DUCK CL, CA | D |
| STILLWATER WMA, NV | D |
| RIO GRANDE RIV, NM | D |
| YAKIMA R, WA | D |
| SUMMER LAKE WMA, OR | D |
| LOS BANOS, CA (2) | O |

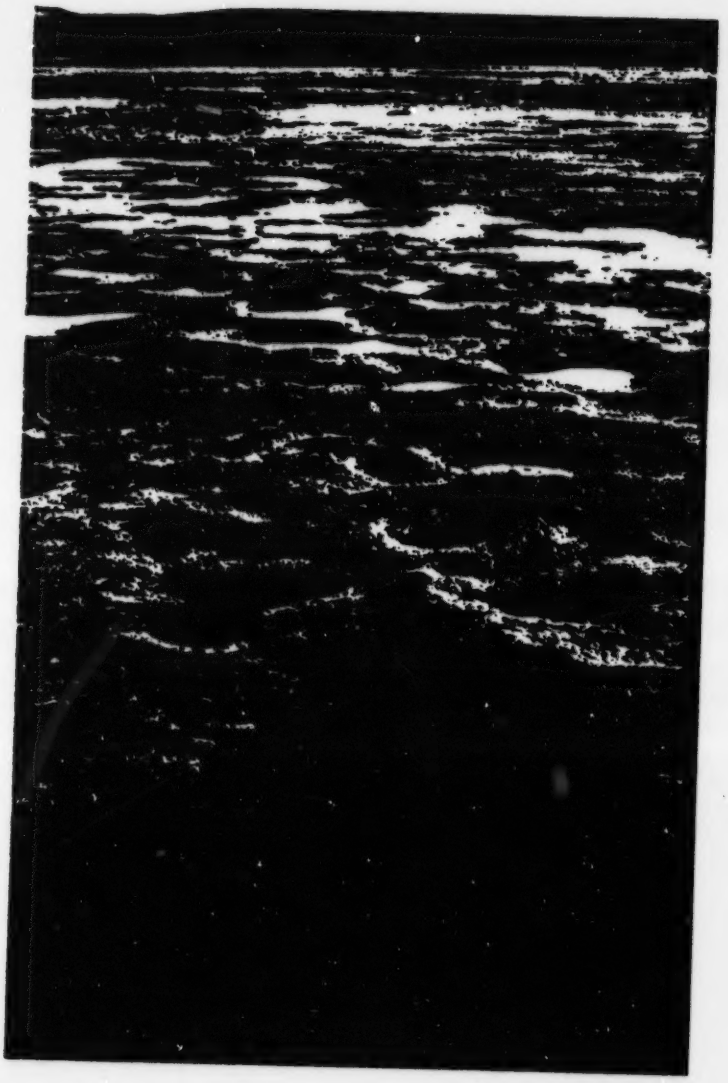


Figure 13: View of aquatic communities in the outer eastern delta showing "craters" left by feeding geese.

The other was grazing of plant communities more remote from the waters edge. In both instances the feeding locations were reached by air. These "feeding flights" took on a very different character depending on the feeding strategy the birds were adopting.

When feeding on aquatic communities, geese flew only infrequently over the exposed delta. Their flight lines basically took them along the waters edge, skirting the outer exposed mudflats (A in figure 14). Flights to feeding areas where grazing was being carried on usually involved longer flight lines over the exposed delta (B and C of figure 14). Plant communities utilized were situated nearer the upper edge of the exposed delta and in the flood plain upstream from the delta. Geese were observed feeding at times up to 40 km from the delta during the day, although the majority of grazing occurred on the upper delta itself.

A feature of goose behaviour was the universality with which one of these two feeding strategies was adopted by the group of geese. The feeding strategy moreover could switch as the year progressed. This change in behaviour seemed most closely correlated with water level changes. As water levels on the delta receded, geese began feeding by cratering the aquatic communities made available by the falling water. When water levels either stagnated or rose slightly, geese changed strategies and began making feeding flights to grazing areas, (see figure 15 and discussion below).

Other species: Swans fed exclusively in areas covered with water. Their feeding strategy resembled geese cratering except they were normally using areas in substantially deeper water. The large craters they created were a feature of the outer delta. Feeding flights were not common, roosting and loafing seemed to occur on the outer exposed delta wherever feeding had last occurred.

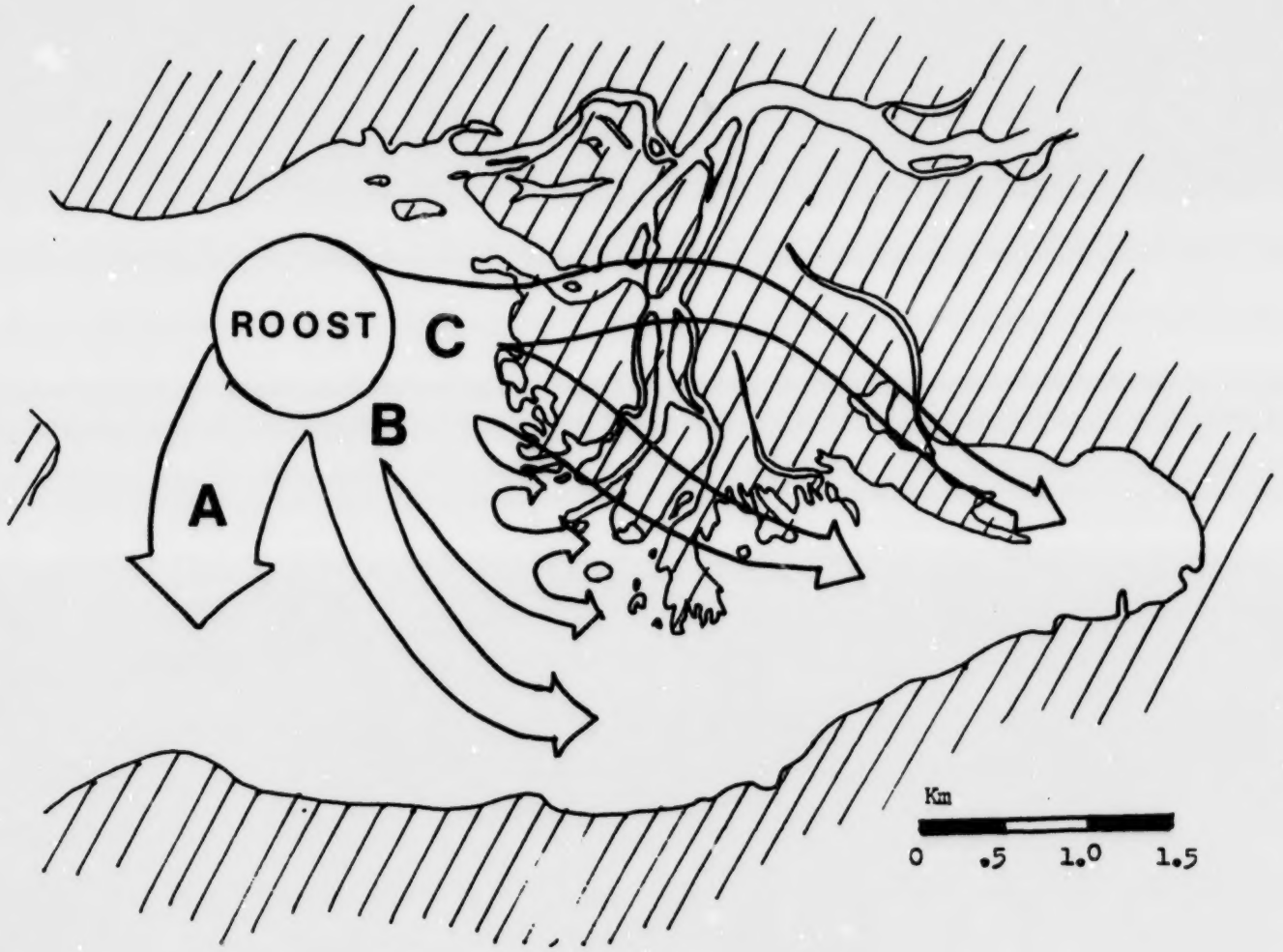



Figure 14. Schematic of Canada goose daily feeding flights and nightly nesting showing three strategies: A, B, C.

Dabbling ducks (notably A. wigeon) primarily fed offshore on aquatic vegetation. Mallards and green-winged teal were normally observed feeding in shallow water in the upper delta. Feeding flights of wigeon and mallard became a daily feature in the late staging period. Their flights apparently accessed areas of the upper delta and the water areas of the eastern extremeties (Colwell Bay). Night roosting apparently occurred offshore.

B. Water Level Regime and Habitat Utilization

All vegetation areas used by feeding geese experienced basically the same annual water regime: they were inundated through the summer and exposed to varying degrees in fall. All years showed a similar general pattern (figure 15).

The vegetation communities exposed to feeding waterfowl included: (a) submerged aquatic communites; (b) emergent communities; and (c) seasonally exposed terrestrial communities. Analysis of the structure of those communities is continuing. A fair understanding of the distribution and composition of the most important areas was possible using our techniques. (Appendix 1).

Submerged aquatic communities were dominated by Potamogeton richardsoni perfoliatus, though other species including P. pectinatus and P. vaginatus were present in apparently pure stands in deeper water and Hipperus vulgaris also formed extensive stands in places. Rhizomes of P. perfoliatus r. were in all likelihood the attraction in most cases when geese were engaged in cratering behaviour. In virtually all cases where craters were examined they were found

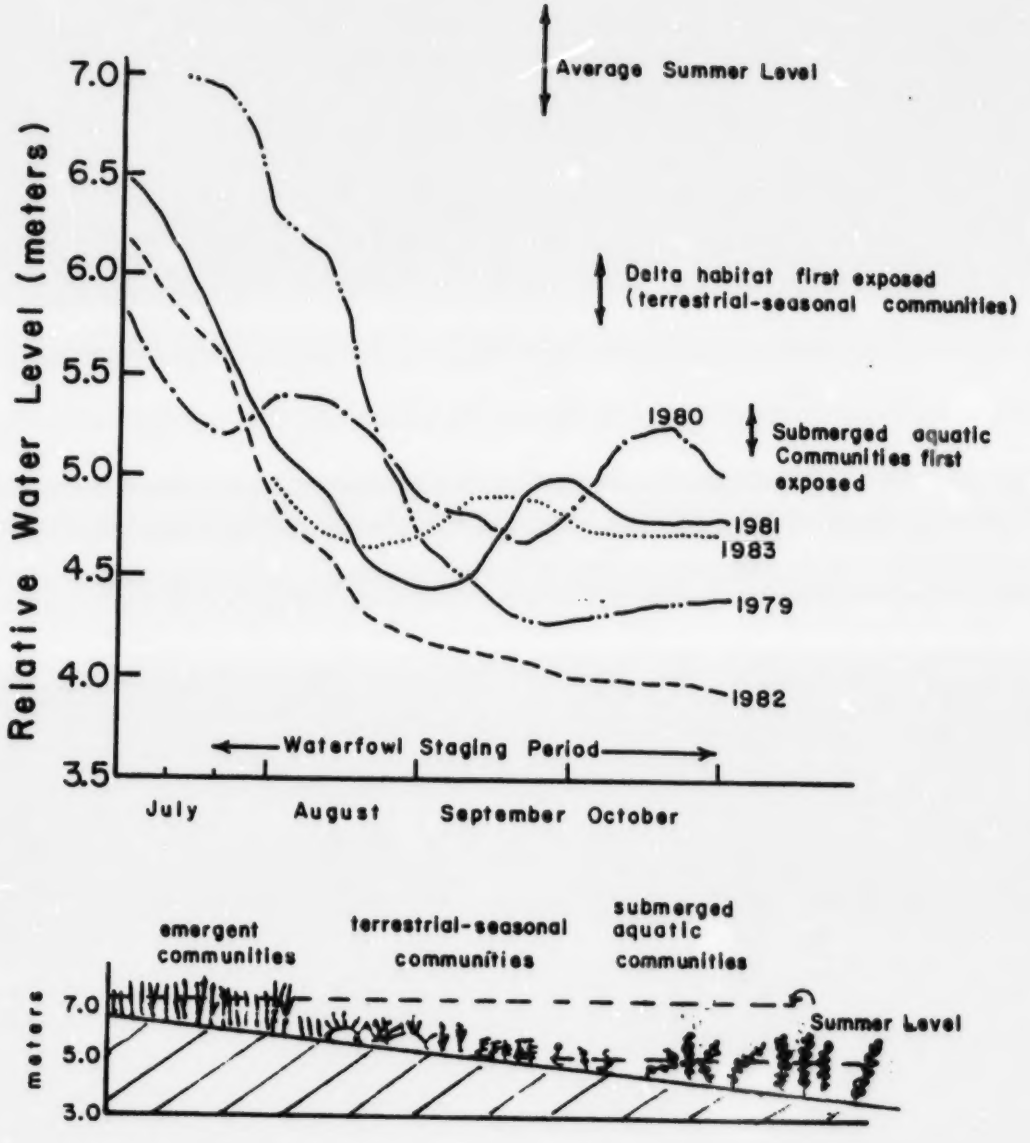



Figure 15. The relative water level on the delta 1979-1983 during the fall staging period showing the relationship between receding water and the exposure of various plant communities.

in submerged aquatic communities dominated by this species and fragments of rhizomes were often found in the water.

Emergent communities also apparently spent at least part of the summer completely inundated. Carex spp. form extensive stands in the central and eastern portions of the Delta. Equisetum grows in pure emergent stands primarily in the eastern delta out of the indirect influence of the active river channels.

The seasonaly exposed terrestrial communities of the delta are less understood but appear to be heavily used by grazing geese. Equisetum sp. grows in extensive stands of low growth form on active bars in the delta and along the river itself. Typically this plant grew to about 10 cm after exposure in late summer. A grass community (Deschampsia caespitosa) in the upper sections of the middle delta likewise apparently began to grow when exposed in early August. Both these terrestrial communities were heavily used by grazing geese especially in the early staging period.

As stated, feeding strategy of geese was closely correlated with the types of plant communities utilized. The overland flights and grazing were used to access the terrestrial and emergent communities and flights primarily over water and cratering were used to access aquatic communites.

The plant communities used were in turn associated with particular water level regimes. Early arriving geese began grazing terrestrial communities through early August. As the level dropped, the much larger submerged aquatic communities were available to feeding birds. The less predictable changes in

water level after the initial drop by late August may be of greatest importance in determining total bird days of staging in any one year. Water levels either continued dropping through the entire staging period (1982) or stagnated at some level (1983) or rose slightly (1981).

As water levels continued to drop, geese carried out fewer overland flights, choosing instead to feed on submerged aquatic plants. When water levels either stagnated at one level for a period of about a week, or rose, geese began overland flights to access emergent and terrestrial communities of the upper delta and river flood plain.

A comparison of events in 1982 and 1981 bear on this relationship between water levels regime and goose behaviour (figure 16). Goose behaviour was graphically different between years; almost no overland flights occurred in later 1982; in 1981 they were the rule. Concurrently 1982 was provided a record number of days of staging while 1981 was only average. The area exposed to feeding birds varied markedly as the water level made the relatively small drop represented by the difference between 1981 and 1982 (figure 17).

C. Disturbance and Natural Predation

Natural predators recorded on the delta were primarily birds of prey. Fox, coyote and lynx probably take waterfowl only occasionally; we saw no sign that these predators were concentrating effort on waterbirds. In 1982, a wolf killed a trumpeter swan which apparently was injured and had difficulty flying. Bald eagles (daily average 5-10 throughout staging period, Table 2) hunted waterfowl and were seen feeding on goose carcasses regularly. They were probably especially effective at capturing wounded waterfowl. Gyrfalcons

Table 2. Avian Predators, Nisutlin Bay

| | Bald Eagle | Golden Eagle | Osprey | R.L. Hawk | R.T. Hawk | Goshawk | Sharp. S. Hawk | Peregrine Falcon | Gyrfalcon | Merlin | A. Kestrel | N. Harrier | G.H. Owl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1981** | | | | | | | | | | | | | |
| August (a) | 13 | | | | 1 | | | | | | | | |
| (b) | 5 | | | | | | | 1 | 1 | 2 | | 1 | 1 |
| September (a) | 8 | | | | | 2 | 1 | 5 | 3 | 5 | | 1 | 2 |
| (b) | 12 | 1 | | 2 | | 1 | | | 1 | 4 | | 15 | 1 |
| October (a) | 4 | | | | | | | | | 1 | | 1 | 1 |
| (b) | 5 | | | | | | | | | | | | |
| **1982** | | | | | | | | | | | | | |
| August (a) | 5 | | | | | | | | 1 | 2 | 1 | 1 | |
| (b) | 6 | | | | | 1 | | 2 | 2 | 10 | | 12 | 1 |
| September (a) | 15 | | | | | | 1 | | 1 | 4 | | 15 | |
| (b) | 5 | | 1 | | | | | | 1 | 2 | | 10 | 2 |
| October (a) | 8 | | | 1 | 1 | | | | | | | 2 | |
| (b) | 3 | | | | | | | | | | | | |
| **1983** | | | | | | | | | | | | | |
| August (a) | 5 | | | | | | | 1 | 1 | 4 | | | |
| (b) | 4 | | | | | | | 2 | 2 | 2 | | 1 | 1 |
| September (a) | 8 | | | | 1 | | | | 2 | 1 | | 2 | |
| (b) | 2 | | 1 | | | | | | 1 | | | 10 | |
| October (a) | 5 | | | 1 | | | | | | | | | |
| (b) | 2 | | | | | | | | | | | | |

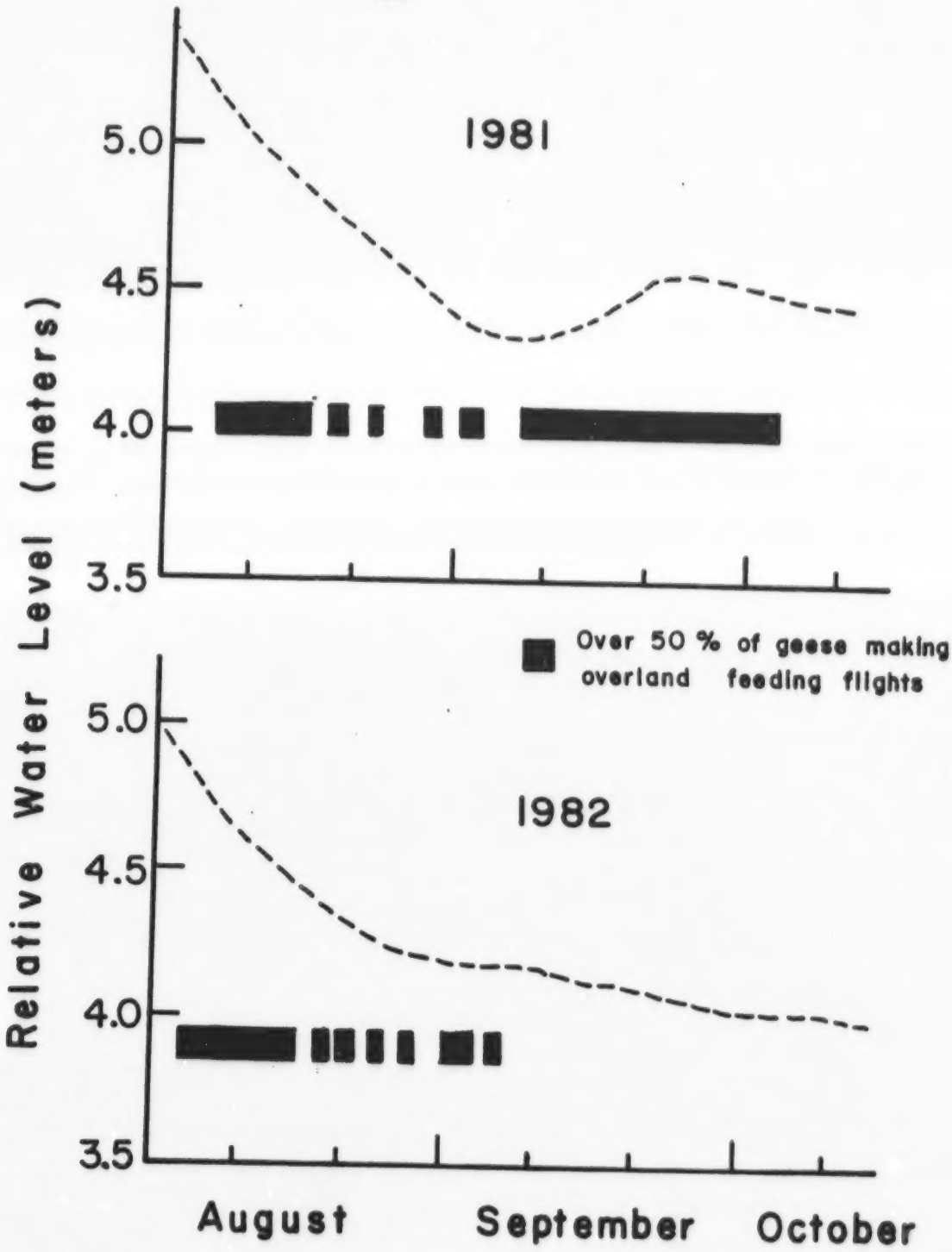



Figure 16. Examples of two water level regimes during fall staging at Nisutlin delca and effect on goose feeding strategy.

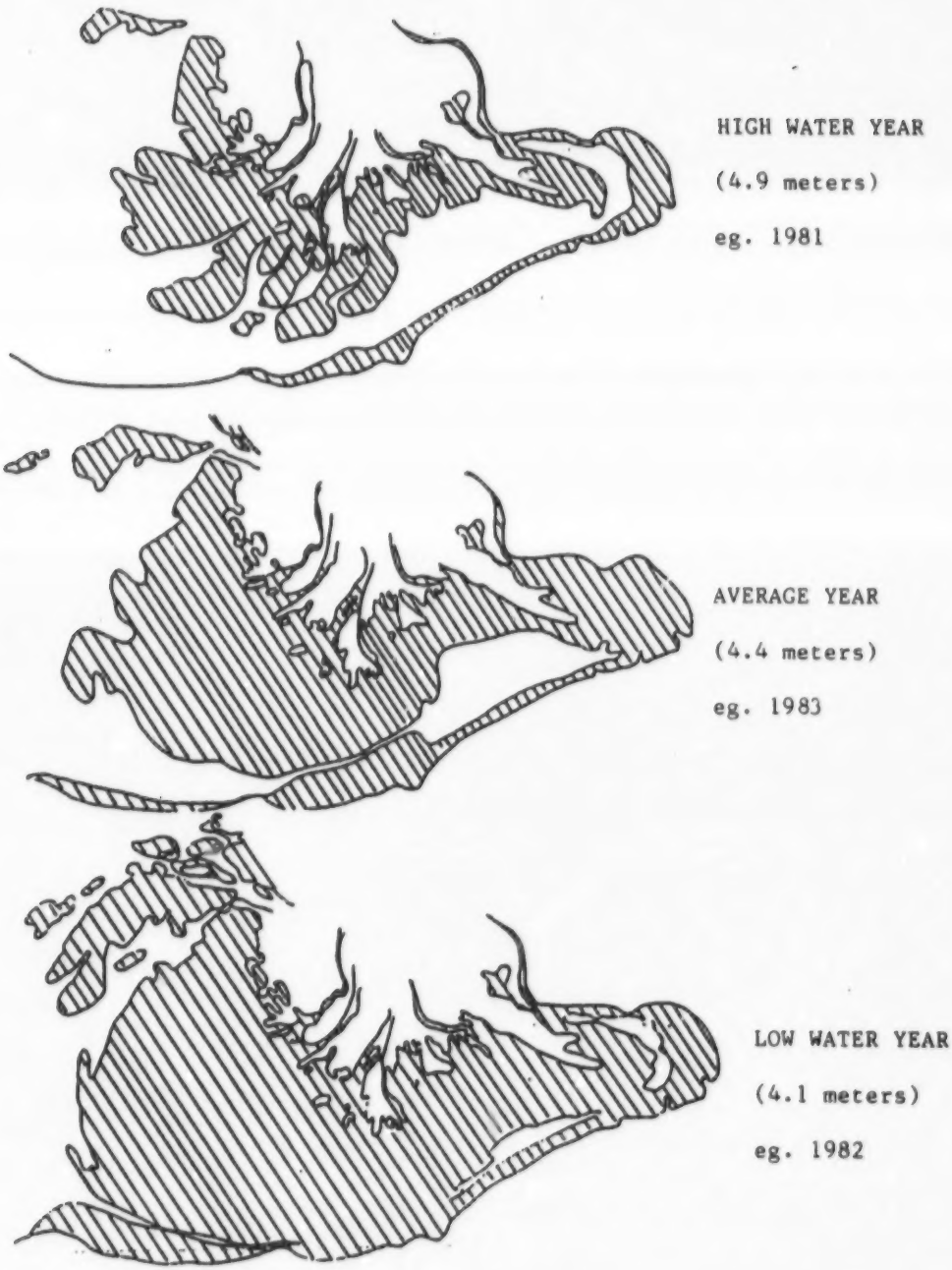



Figure 17 : Amount of exposed area Nisutlin Delta, at lowest water level in average, high and low water years.

(daily average 1-3 throughout staging period) were seen hunting both geese and ducks. Peregrine falcons (daily average 1-2 through early half of staging period only) when present were seen in pursuit of ducks and shore birds. Goshawks, notably in 1981, hunted the edge of the delta and were seen feeding on ducks they had apparently captured. Merlins (daily average 15-20 through early 1/2 of staging period only) were probably mostly hunting shorebirds and songbirds but could presumably take green-winged teal.

The numbers of raptorial birds using the delta although small in absolute number represents a fair concentration due to the limited size of the area. The natural feeding and roosting routines of waterfowl were conceivably influenced by this level of predator activity.

Waterfowl open season commenced September 1. Hunting pressure on the delta varied between years although the pattern of hunter activity was similar (figure 18). A burst of activity on opening was followed by a lull and a series of minor peaks through late September, early October. Cumulative shots fired averaged less than 1000 annually. Well over half the shots fired were recorded in the opening week of the season.

Each year a similar drop occurred in the number of birds counted on the delta following the onset of waterfowl shooting. This was especially evident in the goose data (figure 7). The dramatic decline was in all likelihood a direct result of the severe disturbance of hunting in the relatively small area. Geese were seen at this time in small bays and alternate areas of draw-down marsh at sites along Teslin Lake. In late September an re-invasion of the delta by

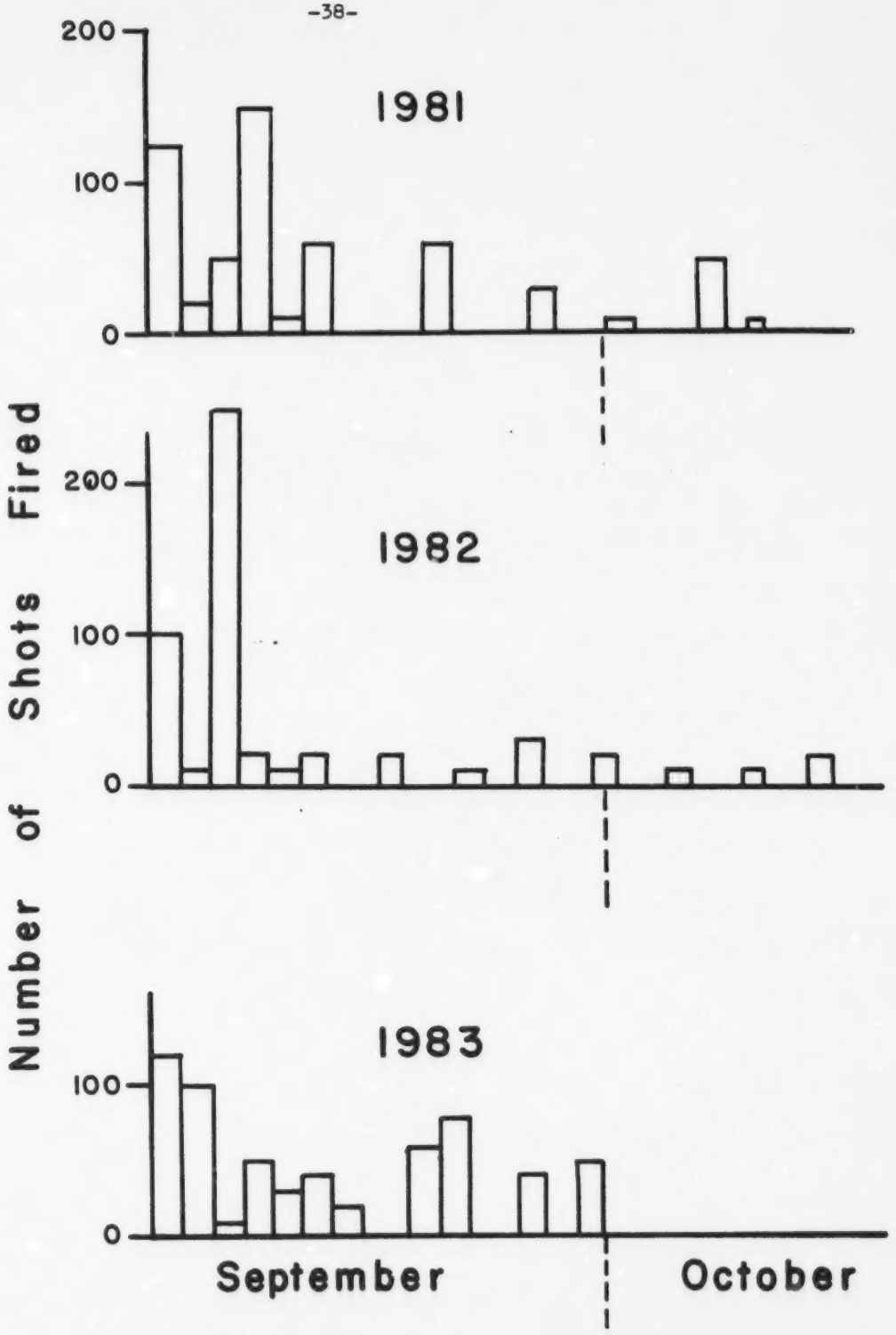



Figure 18. Shots fired by migratory bird hunters on the Nisutlin Delta 1981-83.

geese was recorded every year concurrent with reduced hunter activity at that time.

E. Alternate Staging Habitats

Survey of the Yukon River basin for fall staging habitats is probably less than 50% complete. Large sites (greater than 5 $km^2$ in size) are likely far better known. No new information emerged from the present study identifying unknown major fall staging sites. A fair distribution of these larger sites occurs across the southern portion of the river basin (figure 19). Smaller sites (less than 5 $km^2$) are less well known. Collectively this could represent a significant area of staging habitat.

The Teslin Lake basin was suveyed for minor sites that could provide alternative habitat for birds at the Nisutlin Delta (figure 20). Only very small numbers of geese and dabbling ducks were using the sites during the single survey. No assessment of the total fall staging use made of these sites was possible although many local observations have been made of birds using them during periods of extreme disturbance at Nisutlin.

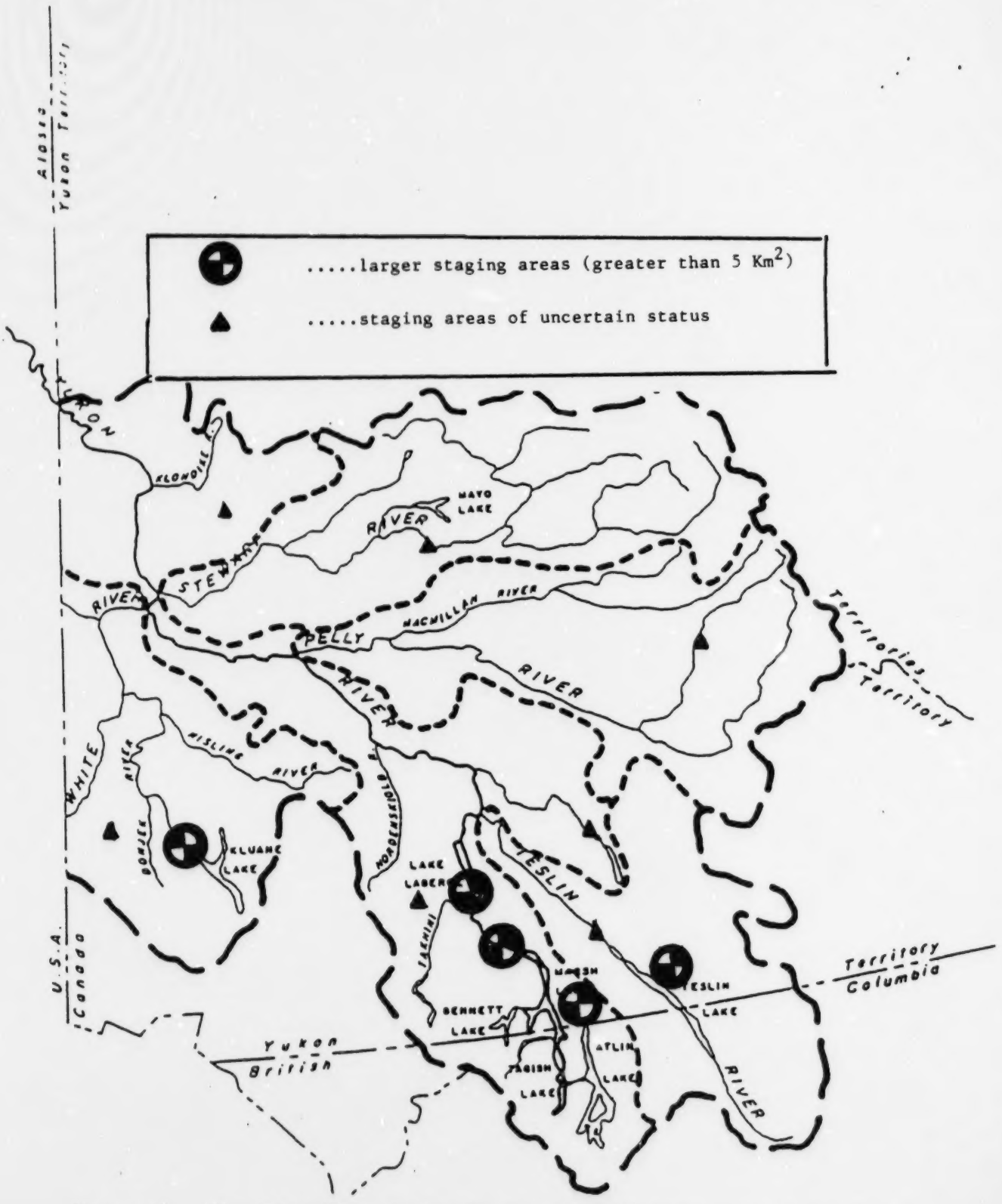



Figure 19. The Yukon River Basin showing locations known major (greater than 5 km$^2$ in size) and smaller staging areas.

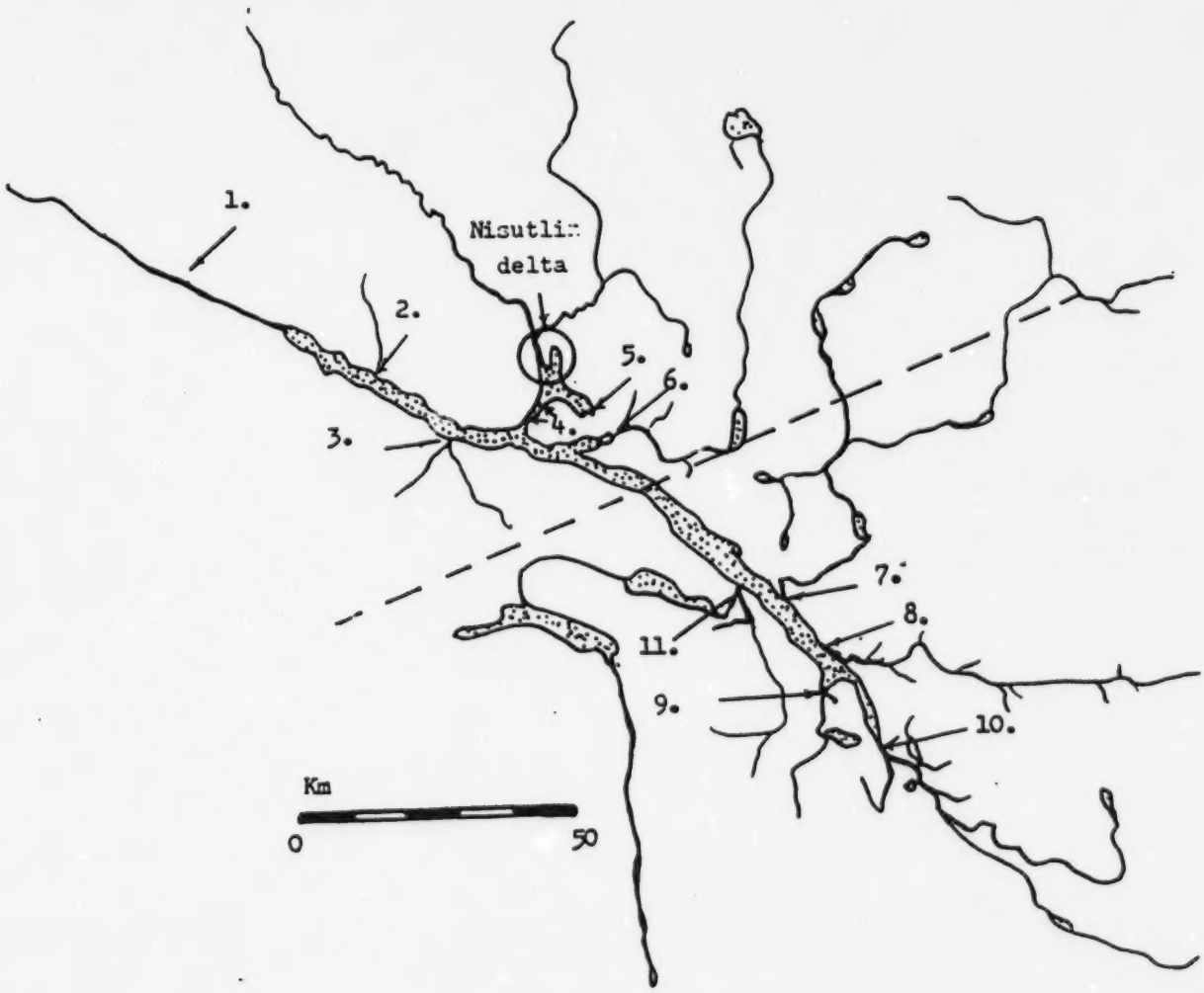



Figure 20. Locations of minor areas of seasonally exposed fall staging habitat in the Teslin Lake system.

## DISCUSSION

### Population Identity and Regional Significance

The regional importance of Yukon River basin staging areas was in part clarified by the results of this study. The pattern of band recovery and retraps as well as the annual build up and decline of absolute numbers of birds is consistent with the idea that the Nisutlin was serving primarily regional or local breeders. The fact that geese arrive so early after moult is evidence of nearby breeding areas. As well, our evidences of little turnover among ducks further lends support. Birds apparently build up in a series of influxes, spend most of the period before freeze up on the area and then move southward.

Understanding of this value is far from complete. However the simple observation that staging habitats of a reasonably large size are relatively rare throughout the extensive area of boreal forest in the southern Yukon, escalates the importance of the few areas known. The area of this regional use apparently extends at least as far as south central Alaska (one band return) as far as ducks are concerned. Tundra swans using the area are also likely Pacific flyway birds breeding in central and coastal Alaska (Bellrose, 1976).

Initial band returns are by in large from Pacific flyway wintering habitats in B. C., Washington, Oregon and California. The fact that Nisutlin birds are apparently faithful to one flyway for wintering further focuses its value and is of help in future management planning on a continental scale. Migration routes between Yukon and these wintering areas are unknown and will be a

priority for future field study. Migration routes traversing basically mountainous terrain are undoubtedly very dependent on restricted wetland areas for staging. The intermountain routes and passes to the Pacific coast are possibly of vital significance.

Given the numbers of birds involved, it could be tempting to conclude a minor significance for the Nisutlin Delta on a continental scale. The only species in numbers of possible continental signficance is the trumpeter swan. This conclusion must be tempered, however, with the observed use of associated minor staging habitats about which far less is known. Collectively the fall staging habitats of the entire Yukon River Basin are likely of far greater significance than is obvious from cursory observation. As well, the huge variation in the numbers and species composition of birds using the area must be taken into account. Northwestern wetlands are known to receive large influxes of birds in years when drought conditions or other adverse events affect more southern breeding areas (King, 1983). The size of waterfowl populations actually affected by the habitat at northern staging areas is thus far larger than indicated by annual use.

Effect of Water Level on Habitat Use and Feeding Strategy

Canada geese dramatically altered their feeding behaviour in relation to water level regime. Apparently as water level dropped below an upper maximum level they began gaining efficient access to the submerged aquatic communities to feed. These largest of the vegetated areas of the delta provided virtually all the feeding as long as water level continued to fall. This strategy broke down when water levels either were too high or when level stagnated at one point for

approximately a week. When this happened, geese would access terrestial and emergent communities. This changed behaviour involved engaging in overland feeding flights whereas the feeding on submerged communities involved over-water flights.

The communities geese fed on first in fall are likely of special importance. Geese arrived first in late July immediately after moulting and were likely in poor condition. At that time, geese fed primarily on the terrestrial communities - notably invading equisetum on sand bars, later on the grass community. Submerged aquatics were apparently not available due to high water levels in early fall. Submerged and possibly emergent communites were fed upon with behaviour described as "cratering". There is every likelihood the ecology of these plant communities is significantly altered by the feeding of the birds. The interrelationships between the two are vital to further understanding the funtions of the delta ecosystem.

This accessing of aquatic plants which grow during summer while the area is inundated (or in the case of the terrestrial communites, in fall after emergence) is the most important waterfowl process of the delta we were able to identify. Directly dependent on the water level regime, the process clearly has serious implications for water management. Management must first and foremost be designed to preserve the areas' receding water levels in August - October.

Disturbance

One feature of most waterfowl staging is predator defense. A model is suggested from our results at Nisutlin Delta wherein predator defense strategy is a dominant force molding goose behaviour. Management to control disturbance is probably of equal significance to water management in maintaining geese at the Nisutlin staging area.

Roosting occurred in the safest location - at the edge of the outer delta usually on an island. Here the birds could see approaching predators in ample time to fly - usually away from the area over the water. The feeding strategy was to access the safest food supply which if available, was the submerged aquatic communities. This was because this food source did not involve flights over land and did not involve feeding on ground near vegetated cover which could conceal predators. Only when this feeding strategy became impracticable because of water level factors did the birds use the more dangerous strategy of overland flights. Our observations suggest that birds feeding in terrestrial and emergent areas were particularly sensitive to disturbance; bald eagles flying near feeding flocks caused them to lift at an unusually long range and fly to the safety of the outer delta. Approach by people was equally disruptive.

Further evidence of the sensitivity of these birds to disturbance is the characteristic decline in numbers of geese as hunting season opened. Hunting on the small area of the Nisultin Delta is a noisy operation. Of significance is the fact that the one year when water levels continued to drop throughout the fall and the geese did not engage in feeding flights overland, was the worst

year for hunter success. Hunters are mostly able to access goose flocks making their overland feeding flights. It is clear that some management of the human hunting effort will be required in future planning for the area.

The smaller, associated habitats nearby became important mostly when birds left Nisultin in early September due to hunter disturbance. These areas, according to the model, suggested would not normally be acceptable staging habitats because of their small size. The fact that geese do not apparently leave the region totally and that numbers rebuild late in September at Nisutlin as birds return, speak of the stress placed on the flocks by this disturbance.

Extrapolation to Other Areas of River Basin

It will be possible to determine the universality of the system described at Nisutlin only as the staging areas of the basin become better known. The critical features of the process as they are currently understood are not difficult to recognize and measure. Moreover, the general flow regime in the Nisutlin/Teslin system is not particularly unique in the Yukon River basin. Falling water levels in fall are the norm, except where headwaters are glacier fed (basically only the White River system) The developing understanding of aquatic vegetation communities associated with this hydrological regime is at the base of understanding the occurrence and subsequently the management of waterfowl fall staging areas of the Basin.

Small areas of fall-draw-down marshes used by waterfowl represent some of the more important unknowns. Their amount of use, extent, and especially their importance as ancillary habitats when in association with one of the larger areas need understanding. The Teslin survey suggests a larger number of these small sites potentially exist throughout the basin. It also illustrates the apparent diversity in methods by which they may form. Creek deltas, barrier beaches, cut-off channels and other features creating protected areas all potentially develop the characteristic aquatic communities.

Larger areas of the size of Nisutlin are relatively rare in the Basin. Two of the larger known fall staging sites (Lewes Marshes and Shallow Bay) are already possibly under some influence of water management as a consequence of the Whitehorse Rapids dam at Whitehorse. The original ecological processes at these areas are thus more difficult to recognize and measure. What historic records do exist relative to bird use, and the condition of remnant vegetation communities suggest a very similar process as at the Nisutlin Delta. The Lewes marshes in particular show large sedge marshes and ample aquatic communities which in historic times apparently largely drained in fall providing large numbers of waterfowl with fall staging habitat. Management decisions affecting these larger areas are thus at very different stages depending on the site. Due to the relative rarity of their occurrence and their great value both to the birds and to recreational waterfowl users, immediate effort is required to begin protecting their critical ecological processes and in some cases, perhaps rebuilding them.

Protection, Enhancement and Mitigation

Most staging areas presumably provide two main features: a food source and protection from predation. By the model suggested in this study, the natural flow regime of the Nisutlin/Teslin river system is responsible for the major features of this process. Inundation and possibly silt deposit during summer are necessary for production of the aquatic vegetation which forms the food source. Exposure during fall with preferably a continuous decline in water level through September and October allows access to the food source and provides the extensive low relief terrain necessary for security. The natural system accepts the disturbance of natural predators through a feeding strategy flexible to habitat changes and including a traditional roosting area and alternate feeding areas, flight lines and activity timing.

Protection for this system clearly involves firstly protection of the food resource through maintaining those hydrological processes responsible for it. As well, protection of waterfowl behavior strategy from consistent disturbance by unnatural activity is probably an equally vital component. Human activities exemplified by recreational hunting had a marked effect on goose behaviour and numbers using the area. Control of this disturbance through sanctuary establishment on part of the area is probably already a necessary management option. This is especially so due to the relatively small extent of the area.

The process as understood at Nisutlin could lend itself to enhancement management through water level manipulation and disturbance control. Dyking and pumping or perhaps simply channel alteration to encourage the building of the delta deposits into shallower waters of the S.E. delta, for example, could

lead to increased areas of aquatic vegetation subject to falling water in late summer and fall. In particular management to maintain the fall draw down through October seems feasible although in many years relatively expensive pumping would be required. Controlling present disturbance has the potential for greatly increasing bird use in early September. As a consequence there is good likelihood the staging period could be extended and access to the resource by sport hunters enhanced.

Mitigation of future disturbances to the system--the chief of which is probably hydro development--becomes feasible for similar reasons. Dyking and pumping, both management practices with which there is some experience, can conceivably save the process in the face of water level control. Construction costs of these schemes, though expensive, are likely to be relatively small compared to most water management schemes such as hydro developments. Maintenance and operational costs will occur annually but again compared to similar demands for hydro generation schemes, these costs will be minimal. Moreover energy demand would be mostly in late summer and fall when hydro sources normally can produce excess power. Of vital importance is a general planning philosophy in which costs to conserve critical components of valuable wildlife processes such as waterfowl fall staging, are accepted as part normal construction and operational costs.

Figure 21 displays an example of intensive management which could be used in the face of hydro development on the Teslin system that would destroy natural flow in the Nisutlin. Basically, the main dyke and control structure would isolate the main active channel in fall (A). Pumping through the main structure will be necessary to reduce water levels in fall. Secondary

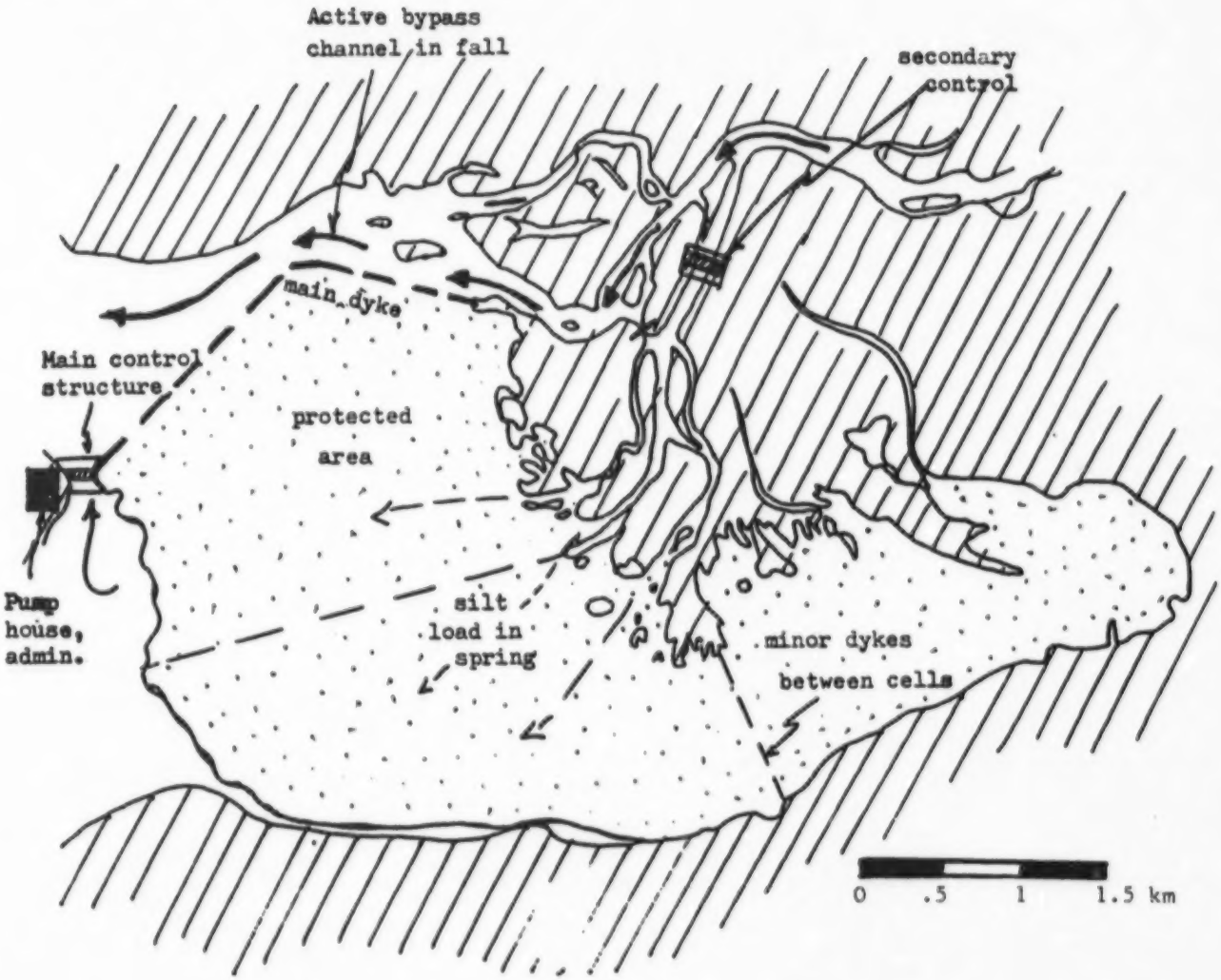



Figure 21. Hypothetical management scheme based on the results of the present study to mitigate a stablized water level regime due to hydro electric power generation demands.

structure in the upper delta would open in spring to direct silt laden water into the control delta. The possibility also exists for dividing the delta into cells by minor dykes.

It follows that similar but perhaps smaller management schemes could be possible throughout the basin. Experimental manipulations with smaller systems may be a valuable present effort as a test of the general model. The Lewes marshes at Whitehorse could lend themselves to such an experiment because of (a) the physical features of the area allow it to be divided into small manageable cells and (b) the suggestion that the flow regime in the marsh has been altered and could be returned to normal. Recognition of the value of these relatively rare pieces of habitat is the first step towards innovative, highly technical management of this type.

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Appendix I

## Preliminary Vegetation Classification of Nisutlin Delta

Owing to the lack of ecological studies, and the importance of the delta to waterfowl and other wildlife, a preliminary effort has herein been made to classify the vegetation communities of Nisutlin Delta and to elucidate the hydrologic processes which influence their distribution. Hopefully, this report will both stimulate and provide the basis for a more indepth study of the vegetational ecology of the delta.

The purpose of this report is to classify the amphibious and aquatic communities of the delta (the willow/driftwood zone being considered the boundary between these and the upland communities) and to produce a cover map of current vegetation.

### Description of Area:

Characteristic of northern latitudes, the Nisutlin Delta is influenced by high water levels of both river and lake in spring and early summer as the winter store of precipitation is released in the spring flood. Following the spring flood, water levels fall in both rivers and lakes throughout the summer and winter, although summer storms may cause periodic floods. The effect of fluctuating water levels is to create zones of vegetation communities related to the period of submergence. As areas build up due to sedimentation during the spring flood, the frequency and intensity of flooding decreases, resulting in a successional sequence from aquatic to amphibious to terrestial vegetation.

The delta ecosystem is an interface between river and lake regimes, with some areas of delta within the river channels being influenced by both. As lake levels fall the river influences the channel area as far as lake water levels; thus these zones are influenced by by either the lake or river regimes depending on water level.

The main channel of the Nisultin River now flows into the west side of Nisutlin Bay, causing the delta to now build out into deeper waters of Nisultin Arm. The large sand bars at the outlet of the river covered with shallow flowing water for much of the summer, conditions favoring the growth of Hipperrus.

Colwell Bay is a restricted basin created by a point of the delta which has cut off a portion of Nisutlin Bay. The area is no longer influenced by the river, as the river channels empty into Nisutlin Bay. The water level in Colwell Bay follows the rise and fall of Teslin Lake levels. However, the outlet of the bay is higher than the low water level of Teslin Lake, and during low water periods the middle of Colwell Bay becomes a stagnant shallow water body. The vegetation communities and the sequence of communities from high water to the aquatic zone is different from those in the cut off and main channel areas in the main part of Nisutlin Bay.

The vegetation of Nisutlin Delta is a complex mosaic of aquatic and amphibiious vegetations due to the interacting influences of three hydrologic regimes: 1) the river regime of Nisutlin River 2) the lake regime of Teslin Lake and 3) the restricted regime of Colwell Bay.

## Methods

### Aerial photography

As the only airphotos available for Nisutlin Bay were taken during high water, it was necessary to first obtain low level photography during low water in July. Low level aerial photography was conducted in July 1983 using a Maule equipped with a floor part and a standard 35 mm SLR camera. Strips were flown. The photographs overlapped to some extent allowing a larger mosaic covering Nisultin Delta to be constructed. Two flight lines were reflown in September 1983. Although the color of vegetation were greatly changed due to senescence, they nevertheless assisted in defining the community boundaries. This was done on a preliminary basis before field trips were conducted. Vegetation plots were located in as many different communites as was possible. However, a refining of the aerial photograph interpretation subsequent to the field trips discovered areas which were not ground truthed.

### Ground Truthing

Field trips were conducted on September 1-2 and September 15-16, 1983. Species cover was estimated and recorded on forms designed by the Yukon ELS program. Difficulty in accessing the aquatic communities results in few plots being established in this zone. Photos were taken of each plot.

Plant specimens were collected at each plot and sent to Bill Cody, Agriculture Canada, Ottawa for positive identification.

Plant communities have described on the basis of one plot in most cases, two in a very few.

Plant Communities

A provisional classification of vegetation communities was arrived at by describing very broad zones identifiable from the air photos. These will be further described as more plots are analyzed:

(1) Upland - dominated by mixed wood and shrub growing on levees and open areas above high water.

(2) Amphibious - communities which grow part of the year in standing water, continuing their annual cycle after the water level drops. Sedges and horsetail dominates.

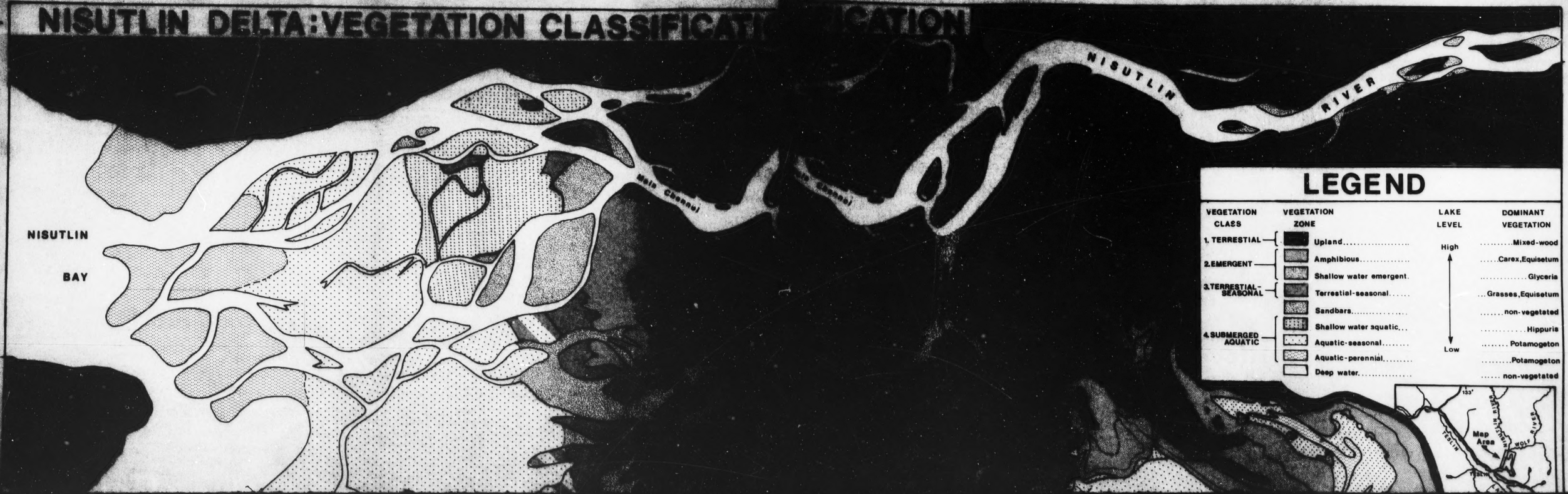
(3) Shallow water emergents - aquatic in the zone is dominated by Glyceria and Hipperus.

(4) Terrestrial Seasonal Communities - these zones are dominated by grasses and other terrestrial plants which remain dormant while submerged, then grow and mature during the fall draw-down.

(5) Aquatic seasonal - dominated by submerged aquatics while becoming dormant in the fall draw-down.

(6) Aquatic - Submerged aquatic perennials.

# NISUTLIN DELTA: VEGETATION CLASSIFICATION



NISUTLIN
BAY
EAGLE
BAY
COLWELL
BAY
CLASS
ZONE
LEVEL
VEGETATION
1. TERRESTIAL
Upland
Mixed-wood
2. EMERGENT
Amphibious
Carex, Equisetum
Shallow water emergent
Glyceria
3. TERRESTIAL-SEASONAL
Terrestial-seasonal
Grasses, Equisetum
Sandbars
non-vegetated
4. SUBMERGED AQUATIC
Shallow water aquatic
Hippuris
Aquatic-seasonal
Potamogeton
Aquatic-perennial
Potamogeton
Deep water
non-vegetated
High
Low
133°
TESLIN
NISUTLIN RIVER
Map Area
WOLF
RIVER
TESLIN
LAKE
YUKON
B.C.
0 10 20 30 40 50
KM
0 0.5 1.0 1.5
KM